PROCEEDINGS

OF THE

Royal Society of Victoria.

VOL. VII. (New Series).

Edited under the Authority of the Council.

ISSUED JANUARY, 1895.

THE AUTHORS OF THE SEVERAL PAPERS ARE SOLELY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

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CONTENTS OF VOLUME VII.

Art. I.—*Observations with Kater's Invariable Pendulums made at Sydney during January and February, 1894; with an Appendix on the Stability of the Pendulum Stand.*

(With Diagram).

By E. F. J. Love, M.A.

[Read 8th March, 1894.]

Introductory.

The object of this investigation was to throw some additional light on the question of the difference between the values of g at Melbourne and Sydney. Two determinations of this difference had already been made; the officers of the United States Coast Survey swung the Kater pendulums at Sydney in 1883, these pendulums being also swung by Mr. Baracchi at Melbourne in 1893; while Lieutenant Elblein swung three of von Sterneck's pendulums at Melbourne and at Sydney in the winter of 1893. When these two sets of results came to be compared,* they were found to be inconsistent; the U.S. Coast Survey figures, combined with those of Mr. Baracchi, show that a pendulum beating approximately seconds should lose 8·58 vibrations per day, if transferred from Melbourne to Sydney; while Lieutenant Elblein's figures give 13·48 as the loss per day. I accordingly decided to swing the Kater pendulums again in Sydney at the earliest opportunity; and, as a matter of fact, the observations in Sydney succeeded those of Mr. Baracchi in Melbourne by a little more than three months. During the interval I made a few measurements in Melbourne; these agree in the main with those of Mr. Baracchi, but are so much less elaborate that there is no need to publish them. The observations in Sydney follow my own in Melbourne at an interval of five weeks. We may therefore reasonably consider that the comparison between Melbourne and Sydney recently secured lacks nothing in point of directness.

* Baracchi—Proc. Roy. Soc. Vict., 1893, p. 176.

Arrangements.

The pendulums and subsidiary apparatus* were carefully packed at the Melbourne Observatory and shipped to Sydney, whither I proceeded on 19th January. Mr. Russell, the Government Astronomer at Sydney, had very kindly placed at my disposal the cellar in which the experiments of the U.S. Coast Survey party, and subsequently those of Lieutenant Elblein, had been carried out; and as the exact position of their apparatus in the cellar is known I erected mine on the same spot. The cellar itself is almost an ideal room for the purpose. Three of the walls are of brick; one, which is two feet ten inches thick, is directly in contact with the earth outside, forming part of the foundation wall of the Observatory; the other two, which are two feet four inches thick, form partition walls separating the room from adjoining cellars, as does also the fourth wall, which is a mass of stone four feet three inches thick, and supports the Transit instrument. At either end of the Transit wall are narrow passages communicating with the adjoining cellar. The ceiling, which is of wooden panels, is level with the ground outside. There are no windows; but at the east end—remote from the pendulum apparatus—a staircase leads up into the Transit room. The dimensions of the cellar are twenty-four feet by six feet five inches by seven feet seven inches. As might be expected from this description the diurnal variation of temperature cannot be detected in this room, even by experiments specially carried out for the purpose.†

The floor, on which the pendulum stand was erected, consists of six inches of concrete resting directly on a bed of very hard clay containing a large number of iron stone nodules. This clay bed, which is nearly one foot thick, is in its undisturbed natural condition and very solid; it rests directly on the Sydney sandstone. A method of testing the stability of the apparatus—and of the floor too—is given in the Appendix.

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* Described in the Report of the Gravity Survey Committee for 1892—Proc. Roy. Soc. Vic., 1892, p. 219.

† I kept the thermographs running whether I were at work or not; on certain days no one entered the cellar, and the records for those days are straight lines. A range in temperature of 0·1° Fahr. could be detected at once by the wave it would produce in the line; but none such was found.

The Shelton clock was supported by a couple of $\frac{7}{8}$in. planks, each of these being secured by large screws to four plugs inserted about eight inches into the wall at the west end of the cellar. The clock was attached to the planks by three screws, and set vertically by inserting mahogany wedges between the planks and the clock case. The verticality, as tested by the spirit level attached to the clock, was well maintained during the whole series of observations.

The relative positions and distances of the apparatus were identical with those employed in Melbourne,* save as regards the position of the observing telescope (*vide infra* p. 5). The operation of inserting the pendulums into the cylinder was considerably simplified by cutting holes in the ceiling of the cellar, and in the floor of the room above; Mr. Russell would then hand the pendulum down through the hole, I receiving it below and guiding it into the cylinder; in this way the pendulums, when not lying in their boxes, were always kept in a vertical position and supported by their upper ends, so that risk of accidental bending was practically eliminated. The uppermost of the two holes, when not in use, was kept closed by a board chamfered to fit its edges, and above this again was a sheet of linoleum; no draught or air circulation through the holes was ever detected during the swings.

PRESSURE AND TEMPERATURE.

The experiments were carried on under atmospheric pressure, the pressure being recorded by a marine barometer lent me by Mr. Russell; the cistern of the barometer was placed approximately on a level with the bob of the experimental pendulum. The barometer corrections are given in Table I.

* Baracchi, *l.c.*, p. 164-66.

Table I.

COPY OF CERTIFICATE OF MARINE BAROMETER, C758, ISSUED BY THE KEW (ENG.) OBSERVATORY.

At	in. 27·5	in. 28·0	in. 28·5	in. 29·0	in. 29·5	in. 30·0	in. 30·5	in. 31·0	Correction to attached Thermo'ter at 62°	Time of falling one inch.
	−0·010	−0·009	−0·007	−0·006	−0·005	−0·003	−0·002	−0·001	+0°.3	5 min. 50 sec.

These corrections include those for index error capacity and capillarity.

(Signed) G. M. WHIPPLE, *Supt.*

Note.—Compared with the standard in Sydney, the error was 0·001 greater.—H. C. R.

The temperature was determined as in Melbourne by means of the thermometers, K667 used in the inverted position, and K668 in the erect position, both attached to the dummy; and as a check on any irregular variations of temperature, the two Richard thermographs were employed. The tracings furnished by these were in all cases so regular, that the mean of the thermometer readings, with the correction $-0^\circ 13$ applied, could be always taken as representing the mean temperature of the pendulum with sufficient accuracy. The thermometers and baromèter were read before and after the observations at the beginning and end of a set of swings; and each recorded reading is therefore the mean of four observations. The fluctuations in barometric pressure were also observed by means of the Observatory barograph; though not large enough to sensibly effect the pressure correction, they influence the observations in another manner, as described in the concluding paragraph of this paper.

Arc of Vibration.

This was read on the arc scale behind the tail-piece of the pendulum, as in previous observations with this apparatus.

Levelling.

The agate planes of suspension for pendulums No. 4 and No. 6 were adjusted to horizontality with the aid of two small but very sensitive levels sent out with the apparatus; each of these stands on three sharp points. The agates belonging to No. 11, being cylinders instead of planes, could not be adjusted with these levels; the two flat-based levels sent out with this pendulum are very sluggish, and not very sensitive; I accordingly employed a very delicate flat-based level, kindly lent me by Mr. Ellery. The planes generally remained in good adjustment as tested by relevelling at the close of the series for each pendulum.

Observation of Coincidences.

In setting up the apparatus the observing telescope had to be rotated to the left of the vertical, so that the observer sat with the pendulum stand on his left. The disappearance and reappearance of the apparent left edge of the image of the disc on the

clock pendulum were in every case selected for observation; this edge would be the apparent right edge to an observer on the opposite side of the room, and consequently was the same as that observed in Melbourne. The card disc on the clock pendulum was that used in Melbourne, and the method of observing was the same as that adopted in Melbourne, Kew and Greenwich. Four sets of swings, two for each face, were effected with each pendulum, the two sets for any one face being taken on the same day. The discordance between the results for opposite faces with the Pendulum No. 11* was very marked; but there is no doubt that this pendulum is slightly bent, and very little question that its knife-edges are not accurately perpendicular to the pendulum bar. I noticed both these defects on the first arrival of the pendulums from England. Fortunately, so long as they are constant they do not affect the accuracy of differential observations.

Clock Rates.

The Shelton clock was compared directly with the Siderial clock of the Observatory at the beginning and end of each day's work, in order to determine the difference of their rates. The comparison was effected by means of a tape chronograph of Morse's pattern, constructed by Messrs. Siemens Bros., which worked very uniformly. The chronograph spaces were measured off by means of a divided lens, the halves of which were mounted on brass sliding pieces carrying scales; this instrument being used in much the same way as the heliometer. The scales were graduated in inches and tenths, and hundredths were estimated.

The error of the Siderial clock was determined by Transit observations. Unfortunately the nights were so cloudy for most of the time that star observations could not always be obtained, and sun transits had perforce to be resorted to; this cannot, however, have affected the results to any serious extent, as on those occasions when both sun and stars were observed the difference of the deduced rates was never more than one or two hundredths of a second. Both clocks behaved well; their rates are given in Table II.

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* Alluded to by Baracchi, *l.c.*, p. 166.

TABLE II.

Date.	January.			February.				
	29th	30th	31st	1st	2nd	3rd & 4th (Mean).	5th	6th
Rate of Siderial Clock belonging to the Observatory - -	−0·54	−0·54	−0·50	−0·43	−0·63	−0·72	−0·54	−0·50
Rate of Shelton Clock - -	+7·18	+7·06	+7·06	+6·99	+6·62	+7·12	+7·10	+7·12

The Observatory Siderial had, as the table shows, a losing rate, and the Shelton clock a gaining rate, throughout the series.

Reduction of the Observations.

This was done in the manner (now well-known) adopted at Greenwich, Kew, and Melbourne. The method of reduction can be easily understood with the aid of the following notation :—

I = duration of a set of swings.

n = number of coincidences in a set.

N = interval between two consecutive coincidences.

N_0 = approximate value of N.

R = number of siderial seconds in a solar day increased by the rate of the Shelton clock = 86636·56 + rate.

B = mean barometric pressure (corrected).

T = mean temperature (corrected).

a, b = initial and final amplitudes in inches.

D, d, r = distances of arc scale from the telescope, tail-piece and knife-edge respectively measured in inches.

V = vibration number.

V_0 = approximate value of V.

I is obtained by subtracting the epochs of the first three from those of the last three coincidences and taking the mean of the differences : N_0 is observed directly during the experiments, and n is obtained by dividing N_0 into I, being the nearest whole number to the quotient : $\frac{I}{n}$ then gives N.

$$\text{Pressure correction} = 0{\cdot}34 \frac{B-26}{1+0{\cdot}0023\ (T-32)} = \beta.$$

$$\text{Arc correction} = V_0 . \frac{\overline{D-d}^2}{16rD} . \left\{ \overline{a+b}^2 - \tfrac{1}{3}.\overline{a-b}^2 \right\}$$

$$= 0{\cdot}13 \left\{ \overline{a+b}^2 - \tfrac{1}{13}.\ \overline{a-b}^2 \right\} = \alpha.\text{*}$$

$$\text{Temperature correction} = 0.45\ (T-62) = \tau$$

$$\therefore V = R - \frac{2R}{N} + \alpha + \beta + \tau.$$

The reduction is to standard temperature 62°F., and standard pressure 26 inches of mercury.

The results are given in Table III.

---

* The coefficient 0·13 is calculated from the following approximate values :—$D = 71$, $r = 50$, $d = 1$, $V_0 = 86000$.

Pendu	β	τ	V	Mean for Face.	Mean for Pendulum.
·58	+1·191	+3·429	86087·182	86087·16	86087·10
57	+1·190	+3·465	86087·143.		
No. 4 83	+1·198	+3·420	86087·287	86087·04	
54	+1·184	+3·510	86086·799.		
50	+1·190	+3·506	85987·291	85986·88	85987·12
44	+1·198	+3·555	85987·432.		
No. 41	+1·182	+3·425	85986·849	85987·36	
48	+1·190	+3·488	85986·908		
41	+1·226	+3·560	86037·195	86037·54	86038·40
43	+1·208	+3·681	86037·894		
No. 1 57	+1·205	+3·672	86039·128	86039·26	
49	+1·195	+3·834	86039·384		

ds.

In order to render these results comparable with those taken at other places they must be reduced to vacuum and sea-level.

The reduction to vacuum is

$$0{\cdot}34\frac{26}{1+{\cdot}0023\times 30}=26\times 0{\cdot}34\div 1{\cdot}069=8{\cdot}2693.$$

The height of the pendulum-bob above the sea-level is given by Mr. Russell as 140 feet.

The reduction to sea-level is therefore $\frac{140}{243}={\cdot}5761$.

The sum of the two corrections is 8·8454 or to a sufficient degree of approximation 8·85.

Hence we obtain as the finally reduced vibration numbers

Pendulum No. 4	...	...	86095·95
„ 6	...	...	85995·97
„ 11	...	...	86047·25

The values given by Mr. Baracchi for Melbourne are

Pendulum No. 4	...	...	86107·89
„ 6	...	...	86008·05
„ 11	...	...	86059·68

Hence we obtain for the difference $M-S$.

Pendulum No. 4	...	...	11·94
„ 6	...	...	12·08
„ 11	...	...	12·43
Mean	...	...	... $12{\cdot}15\pm 0{\cdot}19$

Discussion of the Results, and Comparison with Theory.

The first conclusion deducible from these results is that the difference between the vibration numbers for Melbourne and Sydney cannot be deduced from a comparison of the investigations of the U.S. Coast Survey officers with those of Mr. Baracchi, for the difference between the value thus obtained, viz.:—$8{\cdot}58\pm 0{\cdot}32$, and the value $12{\cdot}15\pm 0{\cdot}19$ given above, is more than eleven times the probable error of the first, and nineteen times the probable error of the second. It cannot, therefore, be attributable to unavoidable errors of observation.

Furthermore, the difference cannot be attributed to personal equation as between Mr. Baracchi and myself; for if I use my

own (Melbourne) observations* instead of Mr. Baracchi's, I get nearly the same mean result, though with a larger probable error, $M-S$ coming out $12{\cdot}20 \pm 0{\cdot}47$; the difference 0·05 between the two values (which is less than the probable error of the determination made by either of us, and therefore within the limit of experimental error), is only one-seventieth part of the difference between the results of the two investigations at Sydney.

On the other hand the difference between the values for $M-S$ obtained by Lieutenant Elblein and myself is not extravagant, seeing that our apparatus and mode of experimenting are quite different; moreover, Lieutenant Elblein told me that he looked upon 1 in 100,000 as about his limit of accuracy for any one place; hence his limit of accuracy for the difference between two places would be about 1·7 vibrations per day. My own probable error for a similar difference is about 0·2 vibrations per day; hence the difference of 1·33 between Lieutenant Elblein and myself is well within the limit of experimental error.

We may therefore feel tolerably certain that, if we adopt 12·2 as the value of the difference between the vibration numbers at Melbourne and Sydney, we shall not be far from the truth.

If we compute by Clairaut's formula† the differences between the vibration numbers at Greenwich, Melbourne, and Sydney, and compare the figures thus obtained with the experimental values, we obtain some interesting results, which strongly bear out the deductions of the previous section.

The calculation is effected thus:—

Clairaut's theorem may be put into the form

$$V^2 = V_0^2 \left\{ 1 + \left(\frac{5}{2}m - e\right)\sin^2\lambda \right\} \text{ - - - - } (1).$$

where V denotes the vibration number in latitude λ, V_0 the equatorial vibration number, m the ratio of the centrifugal force at the equator to the force of gravity there, e the ellipticity of a meridian.

* Referred to *supra* p 1. There is, indeed, no reason to suppose that personal equation has any effect on the results of pendulum observations; the results for each station are themselves deduced from the differences between pairs of epochs, and as each epoch of a pair will be affected by the observer's personal equation to the same extent, this source of error is in all cases eliminated.

† It should be mentioned that—in order to avoid any risk of bias in favour of either Lieutenant Elblein's result or that of the U.S. Coast Survey—the calculations here given were intentionally not effected until the observations at Sydney had been completed and reduced.

Hence we obtain, if V_1 and V_2 are the vibration numbers in latitudes λ_1 and λ_2

$$\frac{V_1{}^2 - V_2{}^2}{V_1{}^2} = \left(\frac{5}{2}m - e\right)\frac{\sin^2\lambda_1 - \sin^2\lambda_2}{1 + \left(\frac{5}{2}m - e\right)\sin^2\lambda_1} \quad - \; - \; - \; (2).$$

m is known to be very accurately expressed by 0·0034674; the mean value for e obtained by Colonel Clarke from a comparison of all previous observations is 0·0034223; whence $\frac{5}{2}m - e = 0{\cdot}00525$ with sufficient accuracy for our purpose. Owing to the smallness of this quantity we may omit the term depending on it in the denominator of the right-hand member of equation (2); furthermore, as $V_1 - V_2$ is small compared with V_1 or V_2 we may write the equation thus

$$2\frac{V_1 - V_2}{V_1} = \left(\frac{5}{2}m - e\right)\left(\sin^2\lambda_1 - \sin^2\lambda_2\right) \quad - \; - \; - \; (3).$$

For V_1 in the denominator of the left-hand member of equation (3) we may substitute 86000 without sensible error; and we obtain

$$\begin{aligned} V_1 - V_2 &= 43000 \times 0{\cdot}00525 \times (\sin^2\lambda_1 - \sin^2\lambda_2) \\ &= 225{\cdot}75(\sin^2\lambda_1 - \sin^2\lambda_2) \quad - \; - \; - \; (4). \end{aligned}$$

the formula used in the computation.

The latitudes are as follows:—

Greenwich: $\lambda_1 = 51° \; 28' \; 31''$.
Melbourne: $\lambda_2 = -37° \; 49' \; 53''$.
Sydney : $\lambda_3 = -33° \; 51' \; 41''$.

The experimental values for Greenwich, Melbourne, and Sydney are summarised in Table IV.

TABLE IV.

Station and Observer.		Greenwich (Hollis)	Melbourne (Baracchi)	Sydney (Love)
Pendulum - -	No. 4	86165·19	86107·89	86095·95
	No. 6	86065·09	86008·05	85995·97
	No. 11	86116·83	86059·68	86047·25

From this table we obtain the following differences:—

TABLE V.

Pendulum.	$G-S$	$M-S$	$G-M$
No. 4 - - -	69·24	11·94	57·30
No. 6 - - -	69·12	12·08	57·04
No. 11 - - -	69·58	12·43	57·15
Mean - - -	69·31	12·15	57·16
Calculated - -	68·03	14·82	53·21
Obsd. – Calcd.	+1·28	–2·67	+3·95

Hence, according to Clairaut's theorem the vibration number recently obtained for Sydney is too large as compared with that for Melbourne, and too small as compared with that for Greenwich; while the observed vibration number for Melbourne departs even more widely from that for Greenwich, being nearly four vibrations less than the formula would allow. Unless the pendulums have undergone some serious change in the course of the voyage out, such change being nearly reversed during the voyage to Sydney—a very unlikely concatenation of events—the conclusion to which the figures lead is a defect of gravity at Melbourne, and a similar but much smaller defect at Sydney, as compared with Greenwich. Setting aside any possible difference between the observed and calculated values due to the difference in longitude between Greenwich and the Australian stations,* we may observe that this result was exactly what we might expect. Melbourne being situated forty miles from the open ocean, and about 250 from the deep water marked by the 200 fathom line, is much more of a continental station than Sydney, which is near to the Pacific coast, and on a line with most of it, the 200 fathom line being here within a few miles of the shore; Greenwich, again, is on an island. The general result of pendulum work is to show that proximity to the ocean in continental stations raises the value of g for any given latitude, while an

* We know the figure of the Earth with sufficient accuracy to affirm that any effect arising from difference of longitude must be extremely small.

insular situation raises it still more: consequently $M-S$ should be smaller, $G-S$ greater, and $G-M$ still greater than the calculated value, as is the case.

If, however, we take the U.S. Coast Survey result, all three differences fall below the calculated value; $M-S$ in particular becomes absurdly small, unless we are prepared to assert that g has an abnormally high value at Sydney, owing to local peculiarites which cannot well be allowed for. Such an assertion appears to me to be quite unwarrantable in view of the agreement between the recent determinations of Elblein and myself; and I am in consequence reluctantly compelled to assume that the U.S. Coast Survey determination must not be employed differentially in connection with recent observations with the Kater pendulums.

What the source of the discrepancy may be it is not so easy to determine. The following suggestions may be made:—

(a) That some change has taken place in *all* the pendulums since 1883.

(b) That some error has crept into the reduction of the American observations.

(c) Errors of observing.

Of these *(c)* is practically out of the question, as all three pendulums give nearly the same result; besides the known skill and ability of the American observers would negative such a hypothesis.

(a) is inadmissible; for Herschel's measurements with these pendulums at Kew and Greenwich in 1882 agree very well with those made by Hollis and Constable in 1889, consequently no such change can have occurred during that interval; while the values of $G-M$, $M-S$, and $G-S$, as recently determined, negative the supposition of any serious change between 1889 and 1894.

(b) seems the only possible solution; and it is noteworthy that the error, whatever it be, affects all the pendulums alike. The possible sources of error which could give such a result are limited in number; the only one which suggests itself to me is a systematic change in the sign of the clock rate. Whether anything of this kind has occurred I cannot tell, as I have of course been unable to refer to the original notes of the American observers, which alone could be relied on to settle the matter.

Conclusion.

In the course of the observations, both here and in Sydney, a curious circumstance presented itself, which seems to indicate a peculiarity in the behaviour of the Shelton clock. Any *very rapid* change in the barometric pressure always calls forth *while it is progress* a change in the clock rate. As cases in point, the observations of 30th January and 5th February may be cited. On both these days the barometer fell rapidly during the first series of observations, and the value of V is on 30th January considerably higher for the second series than for the first, while on 5th February the reverse is the case. When, however, no sudden changes of pressure occur the difference between the numbers obtained on the same day is always quite small. Can this be a special property of gridiron pendulums? If so, the following explanation may be tentatively suggested. Possibly, owing to the friction between the rods, the geometrical form of a gridiron pendulum normally lags behind the condition proper to the actual temperature; and the sudden changes of pressure may act like slight shocks, enabling it to suddenly overcome this friction.

In concluding this paper I must express my gratitude to Mr. Russell, who not only placed the resources of the Observatory at my disposal, and aided me in the work in every possible way, but also treated me with the greatest kindness and hospitality during my stay in Sydney. My thanks are also due to the members of the Observatory staff, especially to Mr. Linehan, the chief assistant, who took a great deal of trouble over the clock rates, and helped me in other ways. Lastly, I would express my obligations to the New South Wales Railway Commissioners for their kindness in granting me a free pass over their lines.

Appendix.

On the Stability of the Stand on which the Kater Pendulums are swung.

The copper cylinder in which the pendulums are vibrated, together with the massive timber and iron framework which carries it, was constructed at Dehra Dun for the Indian Trigono-

metrical Survey. I cannot discover any record of experiments directed to discover whether the vibrations of the pendulums set up any corresponding vibration in the cylinder. It appeared desirable to investigate the question; and Mr. Russell very kindly constructed the apparatus here described, and assisted in the conduct of the experiments made with it.

The apparatus is figured in Plate I. *ABD*, Fig. (1),* is an L-shaped brass plate, to which two small plates *M*, *M*, Figs. (1) and (2), are soldered above and below. Through the plates *M*, *M*, screws *T*, *T*, Fig. (2), are passed, terminating in conical pivots which work easily in sockets in the brass plate *EF*; *G*, Fig. (1), is a weak spring fastened to *EF*, and bearing against the arm *AB* of the L-shaped piece, so that when left to itself the arm *BD* is pressed into contact with *EF*; to the arm *BD* a mirror, *C*, is cemented; *P*, Figs. (1) and (2), is a conical steel spike. The plate *EF* is secured by three screws to the wooden block *K*, which is itself screwed to the top of a large iron drum, *H*, filled with water, which stands on the floor. When in use the point of the spike *P* rested perpendicularly against the north window of the cylinder, against which it pressed with sufficient force to bring the arm *BD* parallel to the plate *EF*; it was found that a force equal to the weight of 0·25 ounces was required for this purpose. The plane of the thrust is parallel to the plane of vibration of the pendulum.

At the other end of the cellar a frame carrying a telescope and scale was supported by means of a similar iron drum filled with water, to which it was screwed, in such a way that an image of the scale was thrown into the telescope by the mirror; the telescope was provided with a single vertical crosswire. The arrangement of the telescope and scale is shown in Figs. (3), (4) and (5), and needs no further explanation. The scale was divided on ground glass into inches and tenths, and illuminated by a small bull's-eye lantern placed behind it on the frame. A displacement of one-tenth of a scale division in the image would have been easily detected, especially if oscillatory.

The dimensions of the apparatus were as follows:—Distance from point of spike *P* to vertical line of pivots, 0·75 in. Distance

* Fig. (1) is horizontal, Fig. (2) is vertical.

from scale or object glass to mirror, 167·0 in. Distance from plane of spike to plane of support of cylinder, 43·0 in. An oscillation in the image of amplitude 0·1 scale division (0·01 in.) would accordingly correspond to an angular displacement in the cylinder expressed by

$$\frac{0{\cdot}01}{167} \times \frac{1}{2} \times \frac{0{\cdot}75}{43} \times \frac{648000}{\pi} = 0{\cdot}108 \text{ seconds of arc.}$$

To see whether the apparatus responded easily to small disturbances the following experiments were carried out:—

(a). To test the effect of unsymmetrical vertical thrust.

A brass cylinder weighing 13 oz. was placed in a vertical position on the ledges of the north and south windows of the cylinder alternately; the readings obtained were

No Load.		Load on S. window.		Load on N. window.
21·8	...	——	...	——
——	...	21·2	...	——
——	...	——	...	22·2
——	...	21·2	...	——
——	...	——	...	22·1
——	...	21·2	...	——
——	...	——	...	22·2
21·8	...		...	

[Note.—The pendulum cylinder is fully 100 times the mass of the small brass cylinder employed in this experiment.]

Hence the mean displacement on loading the S. window was 0·6, while the mean displacement on loading the N. window was 0·4; or, in other words, 2½ oz. on the S. window, or 3 oz. on the N. window could be detected. As the line joining two of the three supporting screws of the cylinder ran east and west, and to the south of the third screw, this difference might be reasonably expected; for the load on the south window would tend to relax the pressure on the third levelling screw by rotating the whole cylinder about the E. and W. line through the other two.

(b) To test the effect of horizontal thrust.

The piece of apparatus shown in Figs. (6) and (7) was constructed for this purpose*; *abc* is a brass plate bent nearly at a

* Fig. (6) is vertical, Fig. (7) horizontal.

right angle, and carrying a steel spike *d*; *ff* is another brass plate with a recess cut out at one end to allow the arm *bc* to pass; *e*, *e*, are screws with conical ends, passing through *ff* and bearing into holes in the line of bending of the plate *abc*, thus forming pivots about which it can turn easily; *g* is a circle traced on the upper side of *ab*, its centre being at the same distance from the line of the pivots as is the point of *d*. When in use the point of the spike *d* rested against the south window of the cylinder, the arm *ab* being just lifted off the plate *ff* by the pressure. A mass *h* being placed on *g*, the lever *abc* transmits a horizontal thrust to the cylinder equal to the weight of *h*. The plate *ff* was screwed to a wooden block, in its turn screwed to the top of an iron drum filled with water.

With a brass 1 oz. weight the following readings were obtained.

Loaded.		Unloaded.
6·2	...	—
—	...	7·0
6·2	...	—
—	...	7·0

Consequently a horizontal pressure in the plane of oscillation of the pendulums equal to the weight of $\frac{1}{8}$ oz. would produce a deflection of 0·1 scale divisions.

(c) To test the effect of small impulses.

Taps with the finger dealt as lightly as possible to the south window caused deflections of several scale divisions; the resulting oscillations were however damped out after two or three swings.

The sensitiveness and delicacy of the apparatus being thus demonstrated, the pendulum (No. 11) was set in vibration through an arc about equal to the largest employed in the coincidence observations, and examined at intervals during a quarter of an hour. On no occasion could the slightest trace of oscillation be detected, the image of the scale remaining to all appearance absolutely steady on the crosswire.

The distance betweeen the knife-edges and the plane of support of the cylinder was about six inches; and since the angular excursion, if any existed, could not as shown exceed $0''\cdot05$ on either side of the vertical, the maximum possible linear displacement of the knife-edge from its equilibrium position may be put down as 0·00003 inches, which is about one ten-

thousandth part of the semi-amplitude of the excursions of the pendulum bob. The sufficient stability of the apparatus is amply guaranteed by this result.

Early in the course of the experiments it was noticed that certain changes in the position of the observer, when near the pendulum stand, caused changes in the zero reading, the maximum displacement being produced by the experimentee's crossing the room from north to south or *vice versâ*. Accordingly the observer who adjusted the weights in the statical experiments always retired to a marked position in the room before readings were taken. It appeared worth while to examine the changes in the floor-level thus produced: and the following tests were made for this purpose.

A lead cylinder, weighing 38¼ lbs., was placed at the foot of the south and north pillars of the stand alternately; the readings were

Wt. near South pillar.		Wt. near North pillar.
20·9	...	——
——	...	21·7
20·9	...	——
——	...	21·7
20·9	...	——
——	...	21·8

Hence the displacement of the weight through a space of five feet on a floor six feet five inches wide, caused a change of level amounting to 0′·86, which would correspond to a depression by the weight amounting to 0·00024 inches. Considering the solidity of the flooring, this at first surprised me a good deal; until I reflected that a load of a couple of tons would produce under the same circumstances a depression of about 0·2 inches: now we have only to watch the bending of the railway track under the wheels of a luggage train—in which a load of a couple of tons per wheel is something like the usual thing—in order to see that the depression thus produced in the solid mass of the track is much greater than 0·2 inches; consequently the experiment really demonstrates the exceptional solidity of the floor.

It is necessary to mention that changes of level of the order of magnitude of those produced in these experiments could not be detected by the spirit levels, and would have no sensible effect on the pendulum observations.

Fig. 3.

Fi

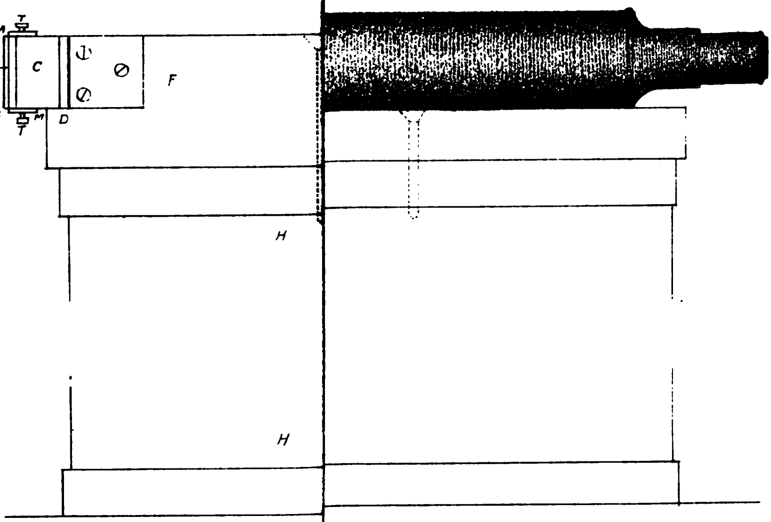
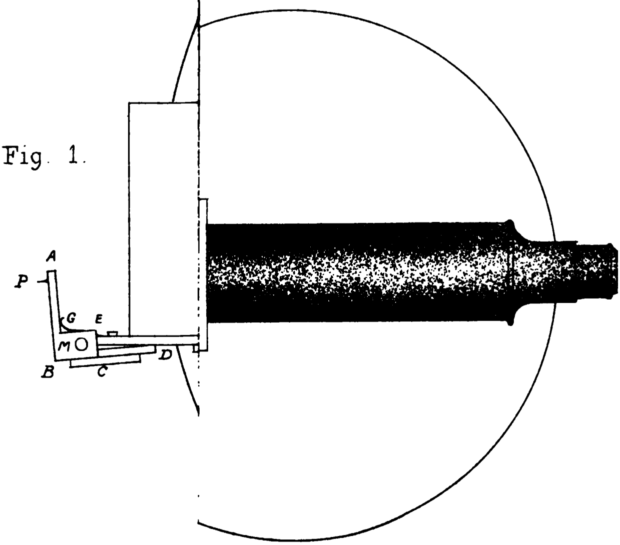


Fig. 5.

Fig. 1.



Art. II.—*Description of some Australian Birds' Eggs and Nests collected at Bloomfield, near Cooktown, Queensland.*

By D. Le Souëf.

[Communicated by Professor Baldwin Spencer.]

[Read 8th March, 1894.]

Crescent-marked Oriole (*Mimeta flavo-cincta*).

These birds were occasionally seen in the open country, and I found their open nest on 3rd November, and secured the parent birds; it was suspended from a fork near the end of a thin bough of a Melaleuca tree, about forty feet from the ground, and difficult to get at. It contained two eggs on the point of hatching.

The tree was growing beside a waterhole, and a Quoy's crow-shrike had its nest in an adjoining tree. The nest is very similar in appearance to that of a Friar bird, and is outwardly composed entirely of strips of bark off a small species of Eucalyptus which grows in damp localities; the inside of the structure is lined with tendrils from the creepers in the scrub, which was about 300 yards away, it measures externally seven inches in length by five inches broad, with a depth of four and a quarter inches, and internal measurement three and three-quarter inches long by two and three-quarter inches broad, and three inches in depth. The eggs are nearly oval in form and of a pinkish-white colour, with a few rounded markings of a dark brown colour, especially towards the larger end. There are also some light grey markings, which have the appearance of being under the surface of the shell. They measure $A\ \frac{20}{16} \times \frac{14\frac{1}{2}}{16}$ inch $B\ \frac{22}{16} \times \frac{16}{16}$ inch.

This egg has not been described before.

NORTHERN SPHECOTHERES (*Sphecotheres flaviventris*).

These birds were plentiful in the open country, and often seen in company with the Friar birds, the bright yellow markings on the breast of the male making him conspicuous.

We noticed them building on a small white gum tree on 18th October, and, going to the tree again on 25th October, found five of their nests on the tree, and also one of the silvery-crowned leatherhead; they were all built near the end of thin boughs, and only one could be got at by our native climber. We could see from below how many eggs were in each nest, the full clutch being three. Our blackfellow had a long thin stick, and, the nests he could not get at, he rolled the eggs out of one by one, and I caught them all uninjured in my hat as they fell. The nests were built of vine tendrils and small twigs, cup-shaped, and rather shallow, and, as before stated, could easily be seen through from below. The one I took measures externally five inches in diameter by three inches in depth, internal diameter three and a quarter inches by one and three-quarter inches in depth. The eggs are of a greenish-grey colour, with various sized irregular markings of a brown colour, with other fainter markings of a purplish hue, they both predominate towards the larger end, the eggs are nearly oval, tapering at the smaller end and measure $A\ \frac{20\frac{1}{2}}{16} \times \frac{15}{16}$ inch $B\ \frac{20}{16} \times \frac{15}{16}$ inch $C\ \frac{21}{16} \times \frac{15}{16}$ inch.

This egg has not been described before.

CAT-BIRD (*Ailuredus maculosus*).

The curious harsh note of this bird was often heard in the scrub and several nests found; they seem to prefer building near the top of a slender tree, about fifteen feet from the ground, although on one occasion we found one within two feet, built on a creeper, but that was an exception; the structure is bulky and composed principally of leaves and twigs, mixed with fine rootlets and lined with finer tendrils, the external diameter of one I took is nine inches, and four and a half inches in depth, internal diameter five and three-quarter inches, and depth two

inches, but they vary in size; the eggs are two in number, and of a pale cream colour and glossy. One pair taken on 27th October measures $A\ \frac{27}{16} \times \frac{18\frac{1}{2}}{16}$ inch $B\ \frac{28}{16} \times \frac{19\frac{1}{2}}{16}$ inch.

Coach-whip Bird (*Psophodes crepitans*).

The call of this bird was occasionally heard in the dense scrub on the higher lands, but the bird itself was seldom seen, it does not appear to be as large as our Victorian one, and it utters a slightly different note, its eggs also are smaller and of a lighter colour. We found its nest on 25th October with two eggs in, built in a thick mass of creepers about three feet from the ground, it was composed chiefly of vine tendrils and small twigs, the ground colour of the eggs was bluish-white, with irregular black markings, slightly more numerous at the larger end, there are also similar markings of a greyish colour appearing as if under the shell, they taper gradually towards the smaller end and measures $A\ \frac{18}{16} \times \frac{13\frac{1}{4}}{16}$ inch $B\ \frac{19}{16} \times \frac{13}{16}$ inch.

Black-fronted Flycatcher (*Monarcha trivirgata*).

These flycatchers were seen only in the scrub, and were very shy birds. All the nests we found were built near the top of slender young trees, about four feet from the ground, and always near a watercourse; their pretty cup-shaped nests were, comparatively speaking, easily seen, they were outwardly composed of fine shreds of bark, pieces of skeleton leaves, a little moss, and all round the nests were fastened pieces of white spider cocoons, and a few of the softer green coloured cocoons made by other varieties of spiders. It gave the nests a curious appearance. All the inside was lined with very fine black rootlets and tendrils, having the appearance of horsehair, its external diameter is two and three-quarter inches by three and three-quarter inches in depth. Two eggs were always found in the nests on different dates in October, and the eggs in various stages of incubation. The eggs have a white ground colour, and are minutely speckled over with reddish-brown spots, which are very much more numerous at the larger end. A pair I took on 28th October measured $A\ \frac{14}{16} \times \frac{10}{16}$ inch $B\ \frac{14}{16} \times \frac{10}{16}$ inch.

QUEEN VICTORIA RIFLE BIRD *(Ptilorhis victoriæ).*

These birds were plentiful in the scrub, and their harsh note often heard, but the birds themselves generally kept out of sight, although they are by no means shy. We were fortunate in securing their nest on 29th October, built in a fan palm not far from the ground, and it contained two eggs, which seems to be a full clutch, another nest was being built in a Cordyline, only eight feet from the ground, when I left, and the eggs taken on 20th November. The nests vary in size, and are very loosely put together, consequently are built either in some thick creeper, or in a fan or other palm, and built close to the trunk and held up by the butt of the stem of the leaf; the hen bird, when sitting on her nest, is not easily disturbed. The external diameter of the nest found on the fan palm was six inches by three and a half inches in depth, internal diameter three and three-quarter inches by two inches in depth, and was composed almost entirely of vine tendrils. These birds often work pieces of the cast skins of snakes into their nests; I saw a piece, on one occasion, three feet long, most of which was hanging down loose. The two eggs were beautifully marked, having a reddish-cream ground colour, and irregular sized streaks of different shades of brown, commencing at the larger end and tapering off to a point, some of the streaks, which are more numerous at the larger end of the egg, are very short, others again continue three-quarters of the way down the surface of the egg and are broader than the short ones; the eggs, which are nearly oval in shape, have a beautiful gloss on them and measure $A\ \frac{21}{16} \times \frac{15\frac{1}{2}}{16}$ inch $B\ \frac{21}{16} \times \frac{15}{16}$ inch.

SUPERB FRUIT PIGEON *(Ptilinopus superbus).*

This beautiful little pigeon was seen on several occasions in the scrub, and we found several of their nests, each with a single egg in, and also secured the parent bird. They seem to prefer building on the higher part of the ranges. We found one nest, with a young one in, built in a small shrub about two feet from the ground, another on 27th October on a small bush which was growing some two feet out of the crevice of a rock overhanging a precipice, and it was with some difficulty that I managed to

secure the egg, others again from eight to ten feet from the ground in small trees. The nest measures three inches in diameter, and is composed of very few twigs. The egg is oval in form, and the one I got on the date before mentioned measures $\frac{22}{16} \times \frac{14\frac{1}{2}}{16}$ inch.

ALLIED FRUIT PIGEON *(Carpophaga assimilis.)*

These large pigeons were far more often heard than seen in the leafy tops of the dense scrub as they fed on the fruit, and frequently on passing underneath the high fruit-bearing trees, we heard the fruit dropping on the ground, showing the pigeons were busy overhead feeding, and we had to look a long time before we could make them out, their green colour making them more difficult to detect. Their nests, which were four inches in diameter, and built of small twigs, were found on several occasions, generally on a thin branch of a small tree some ten to fifteen feet from the ground, and frequently in trees overhanging streams; only one egg was found in each nest. The three I have were taken on 23rd and 27th October, and 3rd November, and measure $A\ \frac{24}{16} \times \frac{17}{16}$ inch $B\ \frac{26}{16} \times \frac{17}{16}$ inch $C\ \frac{25\frac{1}{2}}{16} \times \frac{17}{16}$ inch.

EWING'S FRUIT PIGEON *(Ptilinopus ewingii).*

This beautiful little pigeon was seen in the scrub on the higher land near Bloomfield, but specimens were difficult to secure in the thick vegetation. We were fortunate in finding two of their nests on 24th October, one on the banks of the Annan River, in a small tree about eight feet from the ground, it contained a young bird newly hatched, and the hen bird let us approach within three feet of her nest before she flew off. The other nest was placed in a somewhat similar situation, and contained one fresh egg. They were unusually lightly built, with a few small sticks, and two and a half inches in diameter, and it looked as if the egg could hardly remain on when the bird was off the nest, the egg which is oval in form, and white, measures $\frac{20}{16} \times \frac{13\frac{1}{4}}{16}$ inch.

This egg has not been described before.

Long-billed Green Pigeon (*Chalcophaps longirostris*).

This bird inhabits the northern portion of Australia, and its habits are very similar to its southern ally *Chalcophaps chryso-chlora*.

It is generally to be found on the ground and near streams in the shade of the thick vegetation. We only succeeded in finding one nest and one egg, and that on 5th November, and secured the parent bird. The structure was very lightly built, and not more than ten feet from the ground, and was placed near the end of a thin bough; the egg is white, and measures $\frac{18}{16} \times \frac{13\frac{1}{2}}{16}$ inch.

This egg has not been described before.

Yellow-bellied Flycatcher (*Micrœca flavigaster*), Gould.

This little bird is found in the northern portions of Australia, generally in the open forest country and is fairly plentiful, its cheery note being often heard.

Its beautiful little nest, one of the smallest of Australian birds' nests, was found at Bloomfield, near Cooktown, on 25th October, 1893, and I secured the parent birds. It was built on the dead upper branches of a small tree, about fifteen feet from the ground, and contained one partially incubated egg; there was, apparently, no room for another. It was cup-shaped, the outside being covered with small pieces of bark fastened on with cobwebs at the upper end and hanging, being similar in colour to the bough on which it is built, making it very difficult to detect. Cobwebs are also wound round the nest over the bark, and also round the branch, as if to make the nest more secure; the rest of the structure is composed of fine shreds of bark and grass, very compactly put together. It measures externally one and a half inches in diameter, by three-quarters of an inch in depth, and internal diameter one and a quarter inches by half inch in depth.

The egg is a greyish-white ground colour, spotted with irregular shaped markings of various shades of brown, with underlying markings of grey, especially towards the larger end. It measures $\frac{13}{16} \times \frac{9}{16}$ inch.

This egg has not been described before.

[APPENDIX.]

Notes on a new species of Arses or Flycatcher.

By A. J. CAMPBELL, F.L.S.

It is with pleasure I have to record an addition (a new species) to the list of Australian avi-fauna. During a successful collecting trip to Northern Queensland, Mr. Dudley Le Souëf, Assistant-Director Zoological Gardens, Melbourne, returned with many specimens of Natural history, new to science, amongst which there appeared a Fycatcher, evidently of the genus *Arses*, founded by Lesson. This genus of exceedingly elegant birds, mostly in simple black and white garb, embraces five hitherto known species—four confined to the New Guinea region, and one to Northern Queensland. The sixth species, or last discovered one, differs from the other Queensland bird in possessing a frill or colour upon the back of the neck, and again differs from the other Frilled-necked Flycatchers of the New Guinea region, by having a broad band of black across the breast, but resembles most of all the Little Frilled-neck Flycatcher (*A. aurensis*, Sharpe).

The new species was discovered by Mr. Le Souëf last November (1893), on the Bloomfield River about fifty miles south of Cooktown, Northern Queensland. Mr. Le Souëf informs me that the bird is peculiarly a denison of the thick palm scrubs. Its movements are graceful, and the white frill, which appeared to be erect, imparts a singular appearance to the bird, and serves to at once arrest the eye of the observer. Mr. Le Souëf thought its actions somewhat resembled those of the Tree-creeper (*Climacteris*), especially in its mode of ascending the under side of holes of trees and of scrub in search of insect prey—its chief food. Mr. Le Souëf only saw one pair in addition to a few single birds, which were observed either in the morning or towards evening.

I have proposed the name *Arses terræ-reginæ* for this new species, which may be known on the vernacular list as Le Souëf's

Frilled-necked Flycatcher. In connecting the discoverer's name with this interesting bird, I deem it an honour due to him for his indomitable perseverance and diligence as a field naturalist. Moreover, the name of Le Souëf (in part connection with his father, Mr. A. C. Le Souëf) is a household word amongst field workers and zoological institutions in Australia.

I exhibit here to-night, for comparison, the two Australian *Arses*, namely, *kaupi* and *terræ-reginæ*. During my own excursion to Northern Queensland, 1885, I secured a pair of Kaup's Flycatchers in the Cardwell Scrub. The one exhibited is the female, now in possession of our local taxidermist, Mr. A. Coles; the other was taken over by the the National Museum.

Arses terræ-reginæ, Campbell.

Male.—Head, including ear coverts and side of face, velvety black. Upper part of back, shoulders, broad band across the breast, glossy or bluish-black. Wings, except where blending into a brownish shade at the primaries, and tail, black. Tibial plumes, dusky. Surrounding the back of the neck is a pure white frill or collar joining a white throat and chin. Abdomen, part of under wing coverts, and lower portion of the back also white. In the specimen under consideration there appears some patches of parti-colour on the back, indicating possibly that the bird has not reached mature plumage. In life a narrow disc of beautiful bluish wattle surrounds the eyes, which are dark brown. Bill (narrow) steel-blue; feet black. Total length, 6·3 inches; bill (from gape), ·75; culmen, ·4; wing, 3·25; tail, 3·; tarsus, ·73.

Female.—Judging by analogy, probably resembles those of the other frilled-necked species, in being generally dusky brown or rufous in colour.

Art. III.—*Notes on some Lancefield Graptolites.*

By G. B. Pritchard.

[Read 8th March, 1894.]

In the Proceedings of this Society for the year 1891, Mr. T. S. Hall, M.A., described a new species of *Dictyonema* under the name of *D. grande*. Since the publication of that paper I have been fortunate enough to obtain among some additional examples of the species, an excéptionally perfect and well-preserved specimen, with the hydrothecæ well developed and clearly discernible. Mr. G. Clark, who accompanied me on the occasion of obtaining this prize, kindly drew my attention to a small exposure of the free branches of the polyp-stock on a face of the outcrop, and by exerting a little care I was able to secure both sides of a perfectly entire specimen. I take this opportunity of thanking Mr. Clark for his kindness in so readily handing over his right to this specimen.

Genus Dictyonema, Hall.

Dictyonema, though it has been very often placed among the Graptolites, strictly speaking does not belong to them, as the very characteristic chitinous supporting rod of that group is absent. Professor Nicholson* regards *Dictyonema* as probably an early type of the Order *Thecaphora* of which *Sertularia* and *Campanularia* are living representatives. Zittel† appears to hold the same view, as he places it in the Sub-order *Campanulariæ*.

The genus was originally founded by Professor J. Hall‡ in the following language:—"Fronds consisting of flabelliform or funnel-shaped expansions (circular from compression), composed of slender radiating branches, which frequently bifurcate as they recede from the base. Branches and subdivisions united laterally by fine transverse dissepiments; exterior of branches

* Manual of Palæontology, vol. i., p. 204.
† Handbuch der Palæontologie, Band I., p. 289.
‡ Palæontology of New York, vol. ii, p. 174, 1852.

strongly striated and often deeply indented; inner surface celluliferous or serrate, as in Graptolithus." Although Professor Hall indicates the occurrence of hydrothecæ in the above description, it does not seem to me absolutely clear whether the whole frond bears hydrothecæ or only a portion of it. Judging from the specific descriptions, specimens with the hydrothecæ preserved must have been very rare indeed, as the majority of the species which have come under my notice have been incomplete in this respect.

Zittel* gives the following definition:—"Hydrosome, funnel pannier or fan-shaped, with numerous branches almost parallel, strong, forked and united by cross-threads. The ends of the branches are free, and are then set on one side with pointed hydrothecæ. The latter appear very perishable, and are exceedingly seldom preserved." In this definition it is apparently intended to indicate that only the free ends of the branches bear hydrothecæ. In the specimen now before me the hydrothecæ occur not only on the free ends of the branches, but are also plainly seen on other parts of the frond, and I have been able to trace them almost to the very centre of the polyp-stock.

Mr. T. S. Hall remarks in connection with the description of his species,† that "the diameter of a perfect specimen has not yet been determined, and the hydrothecæ are not visible in any of the specimens." I will therefore avail myself of this opportunity to add the following observations to complete the diagnosis of—

DICTYONEMA GRANDE, T. S. Hall.

The branches where the hydrothecæ are well-developed are from 2·5 mm. to 3 mm. broad. Hydrothecæ long, narrow, mucronate, indent the branches for about one-third the width, free for about one-fifth their length; length 5 mm., breadth of aperture 1 mm., but gradually narrowing towards the back of the branch. The upper margin or aperture is decidedly concave; the lower margin is straight, can be traced to a point opposite the aperture of the third lower hydrotheca, and makes an angle of about 15° with the back of the branch; the mucronate point is set at about twice that angle, which gives a somewhat arched

* Handb. d. Pal., Band I., p. 289.

† Proc. Roy. Soc. Vict., vol. iv., N.S., pt. I., p. 8.

aspect to the upper portion of the lower margin. Hydrothecæ number ten to the centimetre. Breadth of the entire stock, from 24 cm. to about 30 cm.

GENUS TEMNOGRAPTUS, Nicholson.

In 1891 I described a gigantic graptolite under the name *Temnograptus magnificus*, and drew attention to the close relation which undoubtedly existed between it and *T. multiplex*, Nicholson, the type of the genus, and three other species originally described by Professor J. Hall as *Graptolithus flexilis*, *G. rigidus*, and *G. abnormis*. The three last-named species are now regarded as belonging to the genus *Clonograptus*, and according to Dr. O. Herrmann in a paper on the *Dichograptidæ** *T. multiplex*, Nicholson, must also be referred to this genus, as he asserts that *Temnograptus* is not sufficiently distinct from *Clonograptus*. However, in a communication I received from Professor Nicholson he informs me that he is not at all disposed to regard these two genera as identical, also that he regards my species as doubtless congeneric with his *T. multiplex*. I will therefore for the present allow the generic location of my species to stand unaltered.

GENUS CLONOGRAPTUS, Hall.

"Hydrosome bilaterally sub-symmetrical, consisting of more than four simple branches produced by dichotomous division. The spaces between the furcation-points are larger than in *Dichograptus*. Central disc never present."

CLONOGRAPTUS FLEXILIS, Hall.

Graptolithus flexilis, Hall, Geological Survey of Canada Report for 1857, p. 119; also Graptolites of the Quebec Group, p. 103, pl. x., figs. 3-9.

Description.—Polyp-stock multibrachiate, composed of numerous slender branching stipes symmetrically disposed on the two sides of their origin. Sicula, minute; funicle, short, from 1·5 mm. to 2·5 mm. in length, dividing at the extremities at an angle of about 105°; each of these four branches again divides within the space of from 2·5 mm. to 5 mm., making eight principal

* Geo. Mag., N.S., Dec. III., vol. iii., No. 1, p. 25.

branches, which are again several times bifurcated. Hydrothecæ commence above the third bifurcation, that is taking the division of the sicula into two branches, which form the funicle, as the first bifurcation. Stipes slender, flexuous, diverging at a smaller angle at each successive bifurcation; filiform at base, and, where the hydrothecæ are developed, measure from 1 mm. to 1·75 mm. The non-hydrothecal-bearing stipes measure about ·5 mm. in width. In the entire stock there are six bifurcations, giving rise to sixty-four branchlets in all. Breadth of the entire stock about 9 c.m.

Hydrothecæ, short and acute, indent the branches for one-half the width, and are free for nearly one-half their length; length being about four times their diameter; aperture or upper margin, straight, making an angle of 90° with the axis, lower margin straight and inclined to the axis at about 30°. Hydrothecæ number from ten to eleven to the centimetre.

Obs.—In some of the Lancefield specimens the angle at which the parts of the divided extremities of the funicle diverge is a little greater than that mentioned above, being 112° in the specimens under notice; also the length of the four main stipes is from ·5 to 2·5 mm. longer in some examples. The hydrothecæ agree well with the original description. On the whole, the agreement of Lancefield specimens with the American is remarkably close and accurate.

This is, I believe, the first record of the occurrence of this species in Victoria, and is all the more interesting on that account, as it is another example of the wide distribution of Graptolite species.

TETRAGRAPTUS QUADRIBRACHIATUS, Hall.

This species occurs rather commonly associated with the previously described forms from this locality. It is generally somewhat small, and the hydrothecæ are often not preserved, but occasionally a well-developed specimen has turned up with stipes quite two and one-half inches in length.

In addition to the above, I have a new species of *Dictyonema*, *Didymograptus* represented by, at least, one species, *Tetragraptus*, probably two forms, *Leptograptus*, also two forms, and another species of *Clonograptus*. Notes on these I hope to be able to add on some future occasion.

ART. IV.—*Note on the presence of Peripatus insignis in Tasmania.*

By BALDWIN SPENCER,

Professor of Biology in the University of Melbourne.

[Read 8th March, 1894.]

Up to the present time the only record of Peripatus from Tasmania is that of a single specimen described by Mr. J. J. Fletcher.

On the continent of Australia at any rate two, and possibly three, species exist. There are *P. leuckartii*, *P. insignis* and a Victorian form as yet referred to the former species, but which may possibly turn out to be distinct.

In Victoria *Peripatus* has never yet been found in such abundance as Mr. Fletcher has recently described in the case of the New South Wales form, *P. leuckartii*, from the Blue Mountains, and of our two species the one first described by Dr. Dendy as *P. insignis* is comparatively rare.

Whilst in Tasmania during the summer of 1893 I searched hard for *Peripatus* on Mount Wellington, in the Lake St. Clair district, around Dee Bridge and Parattah. Though the localities were apparently favourable ones I only succeeded in finding it at Dee Bridge, where, under fallen logs and within the space of half an acre I found some fifteen specimens.

The interest of these lies in the fact that they are all referable to the species *P. insignis*, with which they agree in the absence of the accessory tooth on the outer jaw, in the possession of fourteen pair of legs, and, generally speaking, in colouration. Just as in the case of *P. leuckartii* there is a wide range of variation in colouration, from very dark purplish-black specimens, in which only the rudiments of a skin pattern can be detected, to others in which the latter is a very marked feature.

A point to notice is the large size of the specimens as compared with those of the mainland—a feature not infrequent in the case

of other forms of life common to Tasmania and the continent. Those described by Dr. Dendy from Victoria measured, after preservation in spirits, about eleven millimetres in length, and one millimetre in greatest breadth. Of the Tasmanian form (killed by drowning and subsequent preservation in spirit), three of the largest measure, respectively, twenty-three, seventeen and fifteen millimetres in length (exclusive of tentacles), and four, three, and three millimetres in breadth, whilst the smaller ones, evidently immature, measure eleven millimetres in length, and one millimetre in breadth.

It is again worthy of note that just as in the case of many other forms so in that of Peripatus we find an alliance between the S.E. part of Australia and Tasmania.

I may add that in the same localities—St. Clair, Dee Bridge, and Parattah, I also found considerable numbers of the land Nemertine—*Geonemertes australiensis*—of which only one specimen has hitherto been recorded from Tasmania.

ART. V.—*Preliminary Notes on Tasmanian Earthworms.*

(With Plates I., II., III., IV. and V.)

BY BALDWIN SPENCER,

Professor of Biology in the University of Melbourne.

[Read 8th March, 1894.]

In two previous communications to this Society I have described as preliminary to a joint work by Mr. Fletcher of Sydney and myself on the Earthworm fauna of Australia the species of Megascolides, Cryptodrilus and Perichæta which had up to the date of publication been found in Victoria. This evening I describe a series of Earthworms from Tasmania, and I have to thank Mr. A. Simson, of Launceston, Mr. A. Morton, of the Tasmanian Museum, and Mr. C. G. Officer, B.Sc., of the Melbourne University, for valuable assistance in collecting. To Mr. Morton I am indebted for several forms, and especially for specimens of the large *Megascolides tasmanianus*, described by Mr. J. J. Fletcher. My own collecting has been done on Mount Wellington, around Dee Bridge, amongst the mountains in the Lake St. Clair district, around Parattah, and to a small extent along the north coast in the neighbourhood of Table Cape and Emu Bay. A visit of the Field Naturalists' Club of Victoria to King Island, enabled me to collect one or two forms in this spot half-way between the continent and Tasmania. The search has not yielded so many forms as I had hoped and expected to find, a result which may possibly be due to the fact that it has been carried on during the summer, but Mr. Officer informs me that earthworms were much more numerous along the King River Valley amongst the western mountain ranges, than in the region of Lake St. Clair, where we were camped out for some four weeks in the early part of 1893.

The same three genera to which our Australian species are provisionally referred are all represented in Tasmania, and to

these genera the Tasmanian forms are likewise provisionally referred, though, as previously stated, it will be necessary to revise the classification when the collections of Mr. Fletcher and myself are sufficiently complete and described.

Up to the present time only a single earthworm is described from Tasmania, viz., *M. tasmanianus, Fl.*

The collection here described consists of 10 species of Cryptodrilus, 2 species of Megascolides, 6 species of Perichæta, all new to science, so that together with Mr. Fletcher's *M. tasmanianus* we now know of the existence of 19 species of earthworms in Tasmania. There must be very many yet undiscovered, especially in the well-watered valleys on the west coast of the island, but so far as yet known the earthworm fauna is not so extensive as that of Victoria or New South Wales.

The following account does not include the description of species which have clearly been introduced from foreign countries.

(a) Cryptodrilus, Fletcher.

(1). *C. irregularis*, sp. n. (Figs. 1, 2, 3). Spirit specimen, 6 inches long, more than $\frac{1}{8}$ inch broad.

Prostomium about half dovetailed into the peristomium.

Clitellum not at all prominent, indicated by darker colour in spirit specimen, and including segments 14-17 and the posterior part of segment 13.

Setæ regularly arranged only so far back as the fourteenth segment, after which they become very irregular and give a decidedly perichæte appearance to the body, though more than four do not appear to be present on each side.

Male pores difficult to determine. There is a ventral median patch on segment 18 of a white tumid nature, and on this the two openings lie either very close together or fused so as to form a single one.

Oviduct pores on segment 14. Ventral of and anterior to the innermost seta of each side.

Spermathecal pores, two in number, at the level of the innermost seta of each side. One between segments 7 and 8, the other between segments 8 and 9.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores not discernible.

Alimentary Canal. Gizzard in segment 5. There are vascular swellings on the oesophagus in segments 9-13, that in segment 13 being especially strongly developed, but it is not nipped off like a true calciferous gland. Large intestine commencing in segment 18.

Blood vascular system. Single dorsal blood vessel with hearts, the last of which is in segment 12. Supra-intestinal vessel in segments 8-12.

Excretory system. Plectonephric with no large nephridia.

Reproductive system. Testes, two pairs in segments 10 and 11, ciliated rosettes in the same segments.

Prostates flattened, racemose in segment 18.

Sperm sacs, saccular and attached to the anterior wall of segment 12.

Ovaries attached to the anterior wall of segment 13, oviducts open into the same segment.

Spermathecæ, two pairs, in segments 8 and 9. Diverticulum not quite half as long as the sac, both being simple in outline.

Habitat. Table Cape, Tasmania, under logs.

(2). *C. polynephricus* (Figs. 4, 5, 6). Length in spirit 5-6 inches. One quarter inch broad.

Prostomium about one half dovetailed into the peristomium. Clitellum distinct, and when fully formed complete, occupying segments 13-17. When not fully formed is incomplete ventrally, and somewhat saddle-shaped. Tumid.

Setæ, four couples regularly arranged. The two inner ones on each side near together, the two outer ones widely apart, the interval between them being twice as great as that which separates the two most dorsal ones. The dorsal and ventral intervals, and that between the second and third setæ of each side are about equal.

Male pores on segment 18 between the level of the two inner setæ on each side.

Oviduct pores on segment 14 ventral of, and anterior to, the level of the innermost setæ.

Spermathecal pores, two in number, on the anterior faces of segments 8 and 9, just dorsal to the level of the innermost setæ. On white elliptical patches.

Accessory copulatory structures. Three pairs of elliptical tumid patches on segments 9, 10 and 11, each placed at the posterior end of the segment at the level of the second setæ. Dorsal pores not visible.

Nephridiopores 10 in each segment. One just in front of each seta, and one between setæ 3 and 4 on each side.

Alimentary canal. Gizzard in segment 5. No true calciferous glands. Large intestine commencing in segment 17.

Excretory system. Five nephridia on each side in each segment, corresponding in position to the setæ, with an extra one between the third and fourth setæ. No ciliated funnels discernible.

Reproductive organs. Testes, two pairs, one in segment 10, another in segment 11. Rosettes in the same segments.

Prostates, large, tubular, somewhat coiled. Extending through segments 18-21.

Sperm sacs, racemose on the anterior septum of segment 12, and the posterior of segment 9.

Ovaries in segment 13. Oviducts opening into the same segment.

Spermathecæ, two pairs, each with a simple diverticulum about one-quarter the length of the sac.

Circulatory system. Single dorsal vessel. Hearts in segments 4-13. In segments 4-9 are small and arise from the dorsal vessel, in segments 9-13 large, and arise from the supra-intestinal vessel which extends through segments 9-13.

Habitat. Mount Wellington, Hobart, and Parattah, Tasmania.

(3). *C. mortoni.* Length in spirits, 2½-3 inches, one-quarter inch broad. In spirit the worm is a flesh colour, and broad in comparison to its length. (Figs. 7, 8, 9).

Prostomium completely dovetailed into the peristomium.

Clitellum well marked, extending over segments 14-17, somewhat darker than the rest of the body in spirit specimens. Tumid.

Setæ regularly arranged in four couples, the intervals between the two couples nearly equal and slightly greater than that between setæ 2 and 3.

Male pores on papillæ on segment 18 just dorsal to the level of the innermost setæ.

Oviduct pores on segment 14.

Spermathecal pores, five in number at the intervals between segments 5 and 6, 6 and 7, 7 and 8, 8 and 9, 9 and 10. Indicated by white glandular spots just dorsal to the level of the innermost setæ.

Accessory copulatory structures. An elliptical tumid patch in the median ventral space between segments 17 and 18; other patches at the level of the second setæ of each side on segment 17 and between segments 18 and 19 and 19 and 20 at the level of the first setæ. The two latter extend inwards near to the mid-ventral line.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores at the level of the third seta on each side.

Alimentary canal. Gizzard in segment 5. True calciferous glands present in segments 13-16. Large intestine commencing in segment 18.

Excretory system. Meganephric.

Reproductive system. Testes in segments 10 and 11. Ciliated rosettes in segments 10 and 11.

Sperm sacs, racemose, attached to the anterior wall of segment 12.

Ovary in segment 13. Oviducts opening into the same segment.

Spermathecæ, 5 pairs, one each in segments 5-9, with a small simple diverticulum less than one-half the length of the sac.

Habitat. Dee Bridge and Mount Wellington, Tasmania. Under logs and stones. I have pleasure in associating with this the name of Mr. A. Morton, Curator of the Hobart Museum, and Secretary of the Royal Society of Tasmania, to whom I am indebted for help in various ways.

(4). *C. hobartensis* (Figs. 10, 11, 12). Length in spirits 3 inches, slightly more than $\frac{1}{8}$ inch broad. The dorsal surface is purple, the ventral is flesh coloured, and the clitellum lighter than the surrounding parts. The setæ are distinct. There is a median dorsal dark line extending on to the prostomium.

Prostomium dovetailed about one half into the peristomium.

Clitellum distinct, tumid, complete occupying segments 14-16 together with the posterior part of 13, and the anterior part of 17.

Setæ in four couples, the two of the ventral couple being nearer to each other than the two of the outer. The fourth seta on each side is near to the dorsal surface.

Males pores on papillæ at the level of the interval between the two inner setæ on segment 18.

Oviduct pores on segment 14.

Spermathecal pores, five pairs at the level of the first setæ between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Dorsal pores, present, the first between segments 4 and 5.

Accessory copulatory structures. Four pairs of elliptical patches at the level of the interval between the first and second setæ between segments 16 and 17, 17 and 18, 18 and 19, 19 and 20.

Alimentary canal. Gizzard in segment 5. The calciferous glands in segments 12, 13, 14 and 15. Large intestine commencing in segment 17.

Circulatory system. Single dorsal vessel. The last pair of hearts in segment 12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 pan 11 into which also open the rosettes.

Prostates. Long, widely tubular and coiled, extending through segments 18-24.

Ovaries in segment 13, into which the oviducts also open.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum simple and not more than half the length of the sac.

Sperm sacs, racemose in segments 9 and 12.

Habitat. Parattah and Mount Wellington.

In internal anatomy this worm is almost identical with *C. mortoni*, but the two are perfectly distinct in external appearance. The worm in question is a whitish stout form, whilst *C. mortoni* is darkly coloured with conspicuous setæ, and is long and narrow.

(5). *C. campestris* (Figs. 13, 14, 15). Length in spirits 2-3 inches, $\frac{1}{8}$ inch broad. Colour when alive whitish with pink clitellum, the same colour retained, only duller, in spirits.

Prostomium dovetailed about $\frac{1}{3}$ into the peristomium.

Clitellum distinct, tumid, occupying segments 13-17, but not the whole of 17 ventrally, so that at its posterior end it is slightly saddle-shaped.

Setæ in four couples, regularly arranged, the dorsal couple of each side being so close to the mid-dorsal line, that only a slight interval is left between the dorsalmost setæ of each side.

Male pores on large papillæ on segment 18, the pore being just within the level of the second seta.

Oviduct opening on segment 14.

Spermathecal pores, two, indicated by small white tumid patches just dorsal to the level of the innermost setæ between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Two large circular patches on segment 17, two elliptical patches on segments 18 and 19, 19 and 20.

Dorsal pores present, the first between segments 3 and 4.

Nephridiopores not visible.

Alimentary canal. Gizzard in segment 5. No true calciferous glands. Large intestine commencing in segment 16. Glandular tufts (pepto-nephridia ?) connected with the alimentary canal in segment 4.

Circulatory system. Single dorsal blood-vessel with the last pair of hearts in segment 12. Sub-intestinal vessel from which in segments 10, 11 and 12 arise the hearts.

Excretory system. Plectonephric with no large nephridia.

Reproductive system. Testes, two pairs in segments 10 and 11 with ciliated rosettes in the same segments.

Prostates small and flattened in segment 18.

Sperm sacs, racemose, attached to the anterior wall of segment 12 and the posterior of segment 9.

Ovaries in segment 13 with oviducts opening into the same segment.

Spermathecæ, two pairs, one each in segments 8 and 9. The diverticulum is rosette-shaped, the sac simple.

Habitat. Parattah, Tasmania, in damp earth under logs.

(6). *C. tesselatus* (Figs. 16, 17, 18). Length in spirit 1 inch. Colouration of the body strongly marked both when alive and in spirits. The body is purplish with the setæ on small white elevations which give it a distinct chequered appearance. A mid-dorsal line runs right forward on to the prostomium. About 65 segments. The peristomium has a mid-ventral cleft.

Prostomium scarcely at all dovetailed into the peristomium.

Clitellum distinct, tumid and occupying segments 13-17 with a mid-ventral continuation including parts of segments 18 and 19 so far dorsal as the level of the second setæ on each side.

Setæ, 4 on each side, the dorsal row very irregular and may be wanting in a few segments, so that occasionally there are only 3 on each side. The third row is regular to within some 6 segments of the posterior end.

Male pores on small papillæ on segment 18 at the level of the interval between the two inner setæ on each side.

Oviduct pores on segment 14.

Spermathecal pores, two in number, at the level of the interval between the two inner setæ of each side, between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Two pairs of small elliptical patches, at the level of the interval between the two inner setæ of each side, between segments 12 and 13, 13 and 14.

Dorsal pores present, the first between segments 5 and 6.

Nephridiopores not discernible.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Large intestine commencing in segment 17.

Circulatory system. Single dorsal vessel. Last pair of hearts in segment 12. Supra-intestinal vessel present (?).

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11, into which the ciliated rosettes open.

Prostates, flattened, small, in segment 18.

Sperm sacs, attached to the anterior wall of segment 12, sacular in form.

Ovaries in segment 13, the oviducts opening into the same segment.

Spermathecæ, two pairs, one each in segments 8 and 9. The diverticulum is simple and less than one-half the length of the sac.

Habitat. Mount Olympus, Lake St. Clair, Tasmania, in damp soil under logs, and amongst decaying leaves in Beech Forest (*Fagus cunninghami*).

(7). *C. insularis* (Figs. 19, 20, 21). Length in spirit 1-2 inches, about $\frac{1}{8}$ inch broad. In spirit is dull purple colour dorsally, pinkish-purple laterally, and flesh colour ventrally.

Prostomium dovetailed about one half into the peristomium.

Clitellum distinct, including segments 14-16 and the anterior portion of segment 17, and the posterior of segment 13. Lighter in colour than surrounding segments.

Setæ regularly arranged save an odd one or two at the posterior end. The two innermost setæ of each side are drawn in towards the middle line in segments 17, 18 and 19, so that the inner couple lie close together on each side.

Male pores on white elliptical patches on segment 18 at the level of the interval between the inner couple of setæ on each side.

Oviduct pores on segment 14.

Spermathecal pores, five in number, placed at the level of the innermost setæ between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. A pair of small elliptical patches at the level of the interval between the two inner setæ of each side, between segments 16 and 17.

Dorsal pores present, the first between segments 5 and 6.

Nephridiopores at the level of the third setæ, the openings indicated by a small white patch on the anterior margin of the segment.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Large intestine commencing in segment 16.

Circulatory system. Single dorsal vessel. Hearts in segments 10, 11 and 12, larger than those in front and arising from the supra-intestinal vessel.

Excretory system. Meganephric.

Reproductive system. Testes in segments 10 and 11, ciliated rosettes in the same segments.

Prostates very long, extending through segments 18-27, tubular, coiled.

Sperm sacs, racemose, on the posterior face of segment 9 and the anterior of segment 12.

Ovaries in segment 13, into which also the oviducts open.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum simple and about one-half the length of the sac.

Habitat. Parattah, Tasmania, under logs.

(8). *C. ellisii* (Figs. 22, 23, 24). Length in spirits 1-1½ inches about ⅛ inch broad. The dorsal surface (in spirits) is dark purple in front of the clitellar region, brown behind this, and dull flesh colour at the posterior end, the ventral surface throughout being lighter in colour than the dorsal. The clitellum is dull flesh colour.

Prostomium dovetailed one-half into the peristomium and marked by a median dorsal line which is continued down the body.

Clitellum distinct, tumid, lighter coloured than the surrounding parts and extending completely over segments 14-16. It may include the posterior part of segment 13.

Setæ in 4 couples regularly arranged. The two inner ones on either side nearer together than the two outer ones. The spaces between setæ 2 and 3, 3 and 4, and dorsally between seta 4 of each side being about equal.

Male pores on papillæ on segment 18, the pore being at the level of the second seta of each side or perhaps slightly ventral of this.

Oviduct pores on segment 14.

Spermathecal pores, three in number, on white elliptical patches at the level of the second setæ between segments 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. Two elliptical patches at the level between the two inner setæ of each side on the anterior faces of segments 10 and 11. Two pairs at the same level between segments 17 and 18, 18 and 19. Two pairs at the same level on the anterior margins of segments 20 and 21.

Dorsal pores present, the first between segments 5 and 6.

Alimentary canal. Gizzard in segment 5. Two pairs of calciferous glands present one each in segment 14 and segment 15. Large intestine commencing in segment 17.

Circulatory system. Single dorsal blood vessel. The last pair of hearts in segment 12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11 into which also open the ciliated rosettes.

Prostates tulular, coiled, occupying segments 17-20.

Sperm sacs, racemose, attached to the anterior face of segment 12 and the posterior of segment 9.

Ovaries in segment 13 into which the oviducts also open. Ovisacs (or additional ovary?) in segment 14.

Spermathecæ, three pairs, in segments 7, 8 and 9. The diverticulum simple and small compared with the sac.

Habitat. Dee Bridge, Tasmania, under logs and stones.

(9). *C. wellingtonensis* (Figs. 25, 26, 27). Length in spirits a little less than 4 inches, $\frac{1}{4}$ inch broad.

Prostomium scarcely dovetailed at all into the peristomium.

Clitellum, tumid, well marked, occupying segments 14-17, and extending slightly into the dorsal surface of segment 18, and incomplete ventrally in the median part of segment 17.

Setæ, the inner couple close together, the dorsal couple not visible.

Male pores on a papilla on segment 18 at the level of the interval between the inner couple of setæ on each side.

Spermathecal pores, two pairs, on white elliptical patches on the anterior margins of segments 7 and 8, at the level of the interval between the two inner setæ of each side.

Accessory copulatory structures. Swollen, tumid ridges on segments 18, 19 and 20.

Dorsal pores present, the first between segments 3 and 4.

Nephridiopores not discernible.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings in segments 9-14. In segment 9 the canal is especially swollen and whitish in appearance. Large intestine commencing in segment 16.

Circulatory system. Single dorsal vessel. Hearts in segments 6-12, those in segments 9-12 larger than the rest, and connected with the supra-intestinal vessel.

Excretory system. Plectonephric, with no large nephridia.

Reproductive system. Testes, two pairs, in segments 10 and 11, the ciliated rosettes opening into the same segments.

Prostates, flattened, racemose surface, in segment 18.

Sperm sacs in segments 9 and 12; racemose.

Ovaries in segment 13 into which also the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. The diverticulum distinct and rosette shaped.

Habitat. Mount Wellington. Tasmania.

(10). *C. officeri* (Figs. 28, 29, 30). Length in spirit 1¾ inch, less than one-quarter inch broad. In spirit the body is a light violet colour dorsally, and flesh colour ventrally, the clitellum being darker than the rest.

Prostomium about three-quarters dovetailed into the peristomium.

Clitellum distinct, tumid, complete, extending over segments 14-17. Purple colour, except the mid-ventral surfaces of segments 15, 16 and 17 where it is light coloured.

Setæ in four couples. Irregular at the posterior end. About one-third of the way down the body the fourth row becomes irregular, then the third and at the very posterior end all four rows may be irregular, but the first and second are quite regular except during the last few segments.

Male pores on papillæ on segment 18, at the level of the second seta on each side.

Oviduct pores on segment 14.

Spermathecal pores, three pairs placed slightly dorsal to the level of the second row of setæ between segments 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. Elliptical patches at the level of the second row of setæ between segments 15 and 16, 16 and 17. A pair at the level of the interval between the two inner setæ between segments 19 and 20.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores not visible.

Alimentary canal. Gizzard well marked, but there are no distinct septa in front of that bounding segment 8 anteriorly. No true calciferous glands, but vascular swellings are present in segments 13-15. Large intestine commencing on segment 17.

Circulatory system. Single dorsal vessel. No continuous supra-intestinal. Hearts in segments 7-12.

Excretory system. Three nephridial tufts on each side of the body—resembling in this respect *C. fastigatus*, and *C. dubius*.

Reproductive system. Testes, two pairs, in segment 10 and 11, the ciliated rosettes opening into the same segment.

Prostates small, flattened, racemose, in segment 18.

Sperm sacs, racemose, in segments 9 and 12.

Ovaries in segment 13 into which the oviducts also open.

Spermathecæ, three pairs in segments 7, 8 and 9. The diverticulum in the form of a group of little finger-like processes, the sac long and irregular in outlines.

Habitat. King River Valley, Tasmania.

(*b*) MEGASCOLIDES, McCoy.

(1). *Megascolides simsoni* (Figs. 31, 32, 33). Length in spirits $1\frac{3}{4}$ inches, $\frac{1}{8}$ inch broad.

Prostomium very slightly dovetailed into the peristomium.

Clitellum complete including when fully grown segments 13-18.

Setæ in four couples. Those of the two inner couples considerably nearer together than those of the outer. The former are regularly arranged all the whole length, the latter become irregular about half-way down the body, though here and there an odd one may be irregular immediately behind the clitellum.

Male pores not very clearly marked on slight papillæ on segment 18 at the level of the innermost seta of each side.

Oviduct pores on segment 14.

Spermathecal pores, two pairs at the level of the innermost setæ between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Two pairs of white elliptical patches at the level of the interval between the two inner setæ between segments 19 and 20, 20 and 21.

Dorsal pores present, the first between segments 4 and 5 (?).

Nephridiopores. A pore is present immediately in front of each seta, so that from the second segment backwards there are eight nephridiopores in each segment, though occasionally one or more on each side may not be visible. In the clitellar region apparently there may be more than eight in each segment.

Alimentary canal. Gizzard in segment 5. No true calciferous glands, but vascular swellings are present in segments 9-16. Large intestine commencing in segment 19.

Circulatory system. Single dorsal vessel. Hearts in segments 8-13, through which also runs a supra-intestinal vessel.

Excretory system. Some four meganephridia (?) in each segment but no funnels visible. Behind the clitellar region sac-like structures lie dorsally and tufts of coiled tubes in two or three rows lie ventral of them and correspond apparently in position to the nephridiopores externally.

Reproductive system. Testes in segments 10 and 11 into which also the rosettes open.

Prostates, small, flattened, and slightly racemose, in segment 18.

Sperm sacs, racemose in segments 11 and 12 attached to the anterior walls.

Ovaries in segment 13 into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. Diverticulum simple and small compared with the sac.

Habitat. Emu Bay and Launceston, Tasmania. This form is associated specifically with the name of Mr. A. Simson, of Launceston, to whose kindness I am indebted for specimens of Tasmanian forms.

(2). *M. bassanus* (Figs. 34, 35, 36). Length in spirit 3½ inches, slightly more than ⅛ inch broad.

Prostomium not at all dovetailed into the peristomium.

Clitellum distinct and saddle-shaped, extending over segments 14-19. The whole of the anterior part of segment 14 is included, but except here the tumid portion extends as far ventrally on each side as half-way between the two inner setæ.

Setæ in four couples, the outer couple on each side twice as far apart as the inner.

Male pores on papillæ on segment 18 at the the level of the innermost setæ. Oviduct pores on segment 14 within the tumid part of the clitellum.

Spermathecal pores, two pairs, at the level of the interval between the two inner setæ of each side between segments 7 and 8, 8 and 9.

Accessory copulatory structures. A median ventral patch on segments 17 and 18. Two papillæ at the level of the innermost setæ joined together by a median ridge in segment 19.

Dorsal pores present, the first between segments 4 and 5 (?).

Nephridiopores at the level of the third setæ (!)

Alimentary canal. Gizzard in segment 5. No true calciferous glands but vascular swellings in segments 13 and 14. Large intestine commencing in segment 19, but there is no clearly marked differentiation between it and the oesophagus in front which is swollen out in each segment.

Circulatory system. Single dorsal blood-vessel. No continuous supra-intestinal. Hearts in segments 8-13.

Excretory system. Meganephric. A single large one in each segment with ciliated funnel as usual.

Reproductive system. Testes not visible, but a pair of well-marked rosettes in segments 10 and 11.

Prostates small and coiled in segment 18.

Sperm sacs, racemose, on the anterior walls of segments 10, 11 and 12.

Ovaries in segment 13 into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. The diverticulum simple and less than half the length of the sac.

Habitat. King Island, in Bass Straits.

(c) PERICHÆTA.

(1). *Perichæta tasmanica* (Figs. 37, 38, 39). Length in spirit $2\frac{1}{2}$ - $3\frac{1}{2}$ inches, one eighth inch broad. There is a dark median dorsal line.

Prostomium dovetailed about one half or one third into the peristomium, which is marked by a median ventral cleft.

Clitellum distinct and complete, occupying segments 13-17.

Setæ. The first setigerous segment has 8 on each side. Back to the clitellum there are 10 or 11, behind the clitellum vary from 12-14.

Male pores on well-marked small papillæ placed (in spirit specimens) in a depression at or very slightly within the level of the innermost setæ of each side.

Oviduct pores on segment 14.

Spermathecal pores. Five pairs between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9, at the level of

Accessory copulatory structures. Median ventral elliptical patches on segments 9, 10, 11, 19, 20, 21 and 22.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. Three pairs of calciferous glands present in 10, 11 and 12. Large intestine commencing in segment 18.

Circulatory system. Dorsal vessel single. Hearts in segments 6-12. In segments 10-12 they arise from the supra-intestinal vessel.

Excretory system. Plectonephric: no large nephridia present. Attached to the walls of the alimentary canal in the first four segments are peptonephridial (?) glands.

Reproductive system. Testes, two pairs, in segments 10 and 11 with rosettes in the same segments.

Prostates flattened and bilobed, but with a single duct in segment 18.

Sperm sacs, racemose in segments 9 and 12.

Ovaries in segment 13 with oviducts opening into the same segment.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. Each consisting of a sac with a diverticulum slightly longer than the sac and with a swollen extremity.

Habitat. Emu Bay, Tasmania, and King Island in Bass Straits.

This form is a member of the group to which belong also *P. rubra*, *P. frenchii*, *P. hoggii*, *P. sylvatica*, *P. steeli* and *P. halli*, all of which are closely allied to one another and agree in the possession of a median ventral cleft on the peristomium, in having five pairs of spermathecæ, in having three pairs of true calciferous glands in segments 10, 11 and 12, in having a plectonephric excretory system, and in having the prostate bilobed.

(2). *P. morœa* (Figs. 40, 41, 42). Length in spirits 4 inches.

Prostomium very slightly dovetailed into the peristomium.

Clitellum not marked externally.

Setæ, in front of the clitellum, vary from 11-18 on each side. Within the clitellum there are twenty-one on each side, and the same number is present behind the clitellum. The setæ form a very definite raised ridge round each segment, and the dorsal and ventral break is very small.

Male pores on papillæ at the level of the interval between the third and fourth setæ.

Oviduct pores on segment 14.

Spermathecal pores, two pairs, at the level of the interval between the first and second setæ between segments 7 and 8, 8 and 9.

Accessory copulatory structures. Median ventral ridge on segment 18 between the two papillæ; a pair of elliptical patches at the level of the interval between the first and second setæ between segments 19 and 20.

Dorsal pores present, the first between segments 3 and 4. Nephridiopores at the level of the ninth or tenth seta in the middle of the body.

Alimentary canal. Gizzard in segment 5. No true calciferous glands present. Large intestine commencing in segment 17.

Circulatory system. Single dorsal vessel. Hearts in segments 6 to 12. Supra-intestinal vessel present.

Excretory system. Meganephric.

Reproductive system. Testes in segments 10 and 11, into which also open the rosettes.

Prostates, extending through segments 17-20.

Sperm sacs, racemose in segments 9 and 12.

Ovaries in segment 13 into which open the oviducts.

Spermathecæ, two pairs in segments 8 and 9. The diverticulum simple.

Habitat. Lake St. Clair district, Tasmania.

(3). *P. richea* (Figs. 43, 44, 45). Length in spirit 3 inches, about $\frac{1}{8}$ inch broad. Dorsal surface (in spirit) purplish colour, ventral flesh coloured. A dark median dorsal line.

Prostomium about one-half dovetailed into the peristomium.

Clitellum complete, distinct, lighter than the surrounding parts, and occupying segments 14-17.

Setæ, 12 on each side in front of the clitellum, behind this the number is greater being 24 half-way along the body.

Male pores on papillæ at level of interval between the first and second setæ.

Oviduct pores on segment 14.

Spermathecal pores, five pairs, on small tumid, elliptical patches on the posterior margins of segments 4, 5, 6, 7, 8 and 9 at the level of first setæ.

Accessory copulatory structures. None developed.

Dorsal pores present, the first between segments 3 and 4.

Alimentary canal. Gizzard in segments 3 and 4. No true calciferous glands, but in segments 11 and 12 the oesophagus is white and swollen. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. Supra-intestinal vessel in segments 9-12. Hearts in segments 5-12, those in segments 9-12 large.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11. Rosettes in the same segments.

Prostates, wide, tubular, in segments 17-19.

Sperm sacs, racemose, in segments 9 and 12.

Ovaries in segment 13 into which also the oviducts open, an extra pair of ovaries (or ovisacs ?) in segment 14.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum is very small at the base of the large simple sac.

Habitat. Under logs in the Beech Forest on Mount Olympus, Tasmania.

(4). *P. dilwynnia* (Figs. 46, 47, 48). Length in spirit 2 inches, ⅛ inch broad.

Prostomium about one-half dovetailed into the peristomium.

Clitellum distinct, complete, occupying segments 14-17, segments 14-16 tumid, purplish colour, segment 17 not so tumid, but darker than the segments behind.

Setæ. First setigerous segment has 6 behind this back to the clitellum are 7 on each side. For 40 segments behind the clitellum, and up to half-way down the body the rows of setæ are

quite regular, behind this a few more become intercalated but the number on each side never exceed 13.

Male pores on papillæ at the level of the interval between the two innermost setæ.

Oviduct pores on segment 14, very close to, and just ventral of and anterior to, the innermost setæ.

Spermathecal pores, five pairs, at the level of the interval between the first and second setæ, between segments 4 and 5, 5 and 6, 6 and 7, 7 and 8, 8 and 9.

Accessory copulatory structures. A mid-ventral tumid patch on the anterior margin of segment 18, two pairs of patches at the level of the innermost setæ between segments 18 and 19, 19 and 20.

Dorsal pores present, the first between segments 4 and 5.

Alimentary canal. Gizzard in segment 5. In segments 6 and 7 the oesophagus is swollen, white, but not vascular, in segments 8 to 12 it is white, swollen and very vascular, in segments 13-15 it is again white and swollen but not vascular. There are no true calciferous glands. The large intestine commences in segment 17.

Circulatory system. Dorsal vessel single. Supra-intestinal vessel in segments 11 and 12. Last heart is in segment 12.

Excretory system. Meganephric.

Reproductive system. Testes, two pairs, in segments 10 and 11. Rosettes in the same segments.

Prostates wide, tubular with racemose surfaces extending through segments 17-20.

Sperm sacs in segment 12, saccular in form.

Ovaries in segment 13 into which open the oviducts.

Spermathecæ, five pairs, in segments 5, 6, 7, 8 and 9. The diverticulum is simple and very small.

Habitat. Dee Bridge, Tasmania.

(5). *P. scolecoidea* (Figs. 49, 50, 51). Length in spirits $1\frac{1}{8}$ inch, slightly more than one quarter inch broad. The body consists of some 77 segments, the first 12 of which are a fair width, the rest very narrow indeed. The body has the general appearance of a minute annulated sausage.

Prostomium less than one half dovetailed into the peristomium.

Clitellum, not visible.

Setæ very numerous; there are at least 40 on each side, but they are very minute, and difficult to count. There is no continuous or any distinct dorsal break except at the very posterior end; the ventral break is slightly better marked, but is very small.

Male pores on minute papillæ at the level of the fourth setæ in segment 18.

Oviduct pores on segment 14 just in front of the second setæ.

Spermathecal pores, two pairs, at the level of the fourth seta between segments 7 and 8, 8 and 9.

Accessory copulatory structures, none developed.

Dorsal pores present, the first between segments 3 and 4.

Alimentary canal. The whole canal is thrown into coils. Gizzard in segment 5 and very large in comparision to the length of the body. No true calciferous glands. Large intestine commencing in segment 18.

Circulatory system. Single dorsal vessel. Supra-intestinal in segments 8-12. Lateral vessel on either side in segments 10 and 11. The last heart is in segment 12, the first round the gizzard in segment 5.

Excretory system. Meganephric. In segments 2-5 the nephridia appear to consist of a large number of coiled tubules than elsewhere. Peptonephric salivary glands present (?).

Reproductive organs. Testes, two pairs, in segments 10 and 11, rosettes in the same segments

Prostates, small, flattened, racemose in segment 18.

Sperm sacs, racemose in segment 12.

Ovaries in segment 13, into which the oviducts open.

Spermathecæ, two pairs, in segments 8 and 9. Two very small diverticula at the base of a fair sized sac.

Habitat. Under logs in the King River Valley, Tasmania.

This worm is remarkable for its short stumpy nature. It is evidently mature, though in external appearance it does not look so. Mr. Officer who found it tells me that it is very abundant, and never seems to attain to a larger size. It has not the slightest resemblance externally to a perichæte worm, and in spirit at all events the minute setæ project only a very short way from the surface.

(6). *P. irregularis* (Figs. 52, 53, 54). Length in spirit $3\frac{1}{2}$ inches, $\frac{3}{16}$ inch broad. The dorsal surface (in spirit) is purplish brown, the ventral is flesh coloured, and the setæ form a very distinct ring.

Prostomium dovetailed about one-half into the peristomium.

Clitellum distinct, complete, occupying segments 13-17 and the anterior portion of segment 18 dorsally. Tumid, and purple colour dorsally, ventrally lighter coloured. Does not hide either the setæ or the dorsal pores.

Setæ, about 13 on each side in front of the clitellum, 16 on segment 14, 15 on segment 17, 15 in the segments in the middle of the body increasing to 20 on the posterior segments.

Male pores on papillæ at the level of the interval between the second and third setæ on segment 18.

Oviduct pores on segment 14.

Spermathecal pores, three pairs. The first between segments 6 and 7 at the level of the third setæ, the second between segments 7 and 8 at the level of the fourth setæ, the third between segments 8 and 9 at the level of the fifth setæ.

Accessory copulatory structures, two pairs of elliptical patches at the level of the third setæ between segments 18 and 19, 19 and 20.

Dorsal pores present, the first between segments 4 and 5.

Nephridiopores at the level of the interval between the eighth and ninth setæ.

Alimentary canal. Gizzard in segment 6. No true calciferous glands, but in segments 14, 15 and 16 the oesophagus is swollen and vascular. Large intestine commencing in segment 17.

Circulatory system. Dorsal vessel single. The last pair of hearts in segment 12. Supra-intestinal vessel in segments 8-12.

Excretory system. Meganephric.

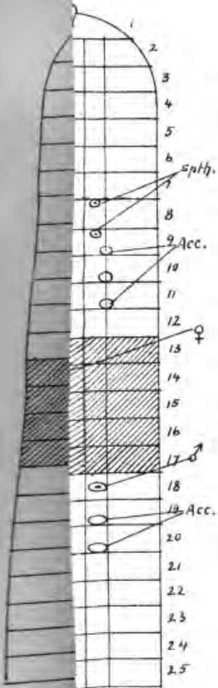
Reproductive system. Testes, two pairs, in segments 10 and 11, the rosettes opening into the same segments.

Prostates widely tubular, coiled, extending through segments 17-21.

Ovaries in segment 13, the oviducts opening into the same segment.

Spermathecæ, three pairs, in segments 7, 8 and 9, each consisting of a large sac with a small simple diverticulum attached to its stalk. Special blood-vessels pass on to the surface of the sac.

Habitat. King River Valley, Tasmania.



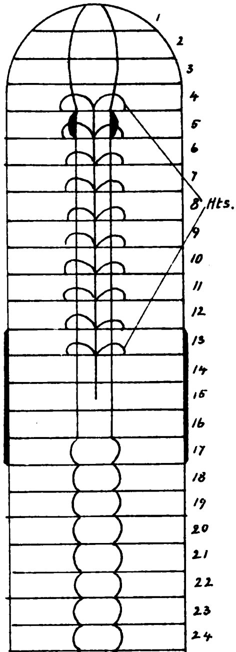


Fig 5

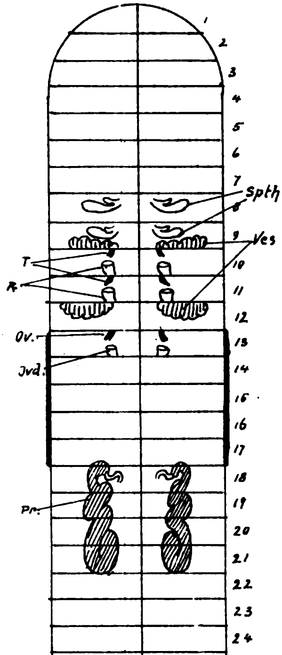
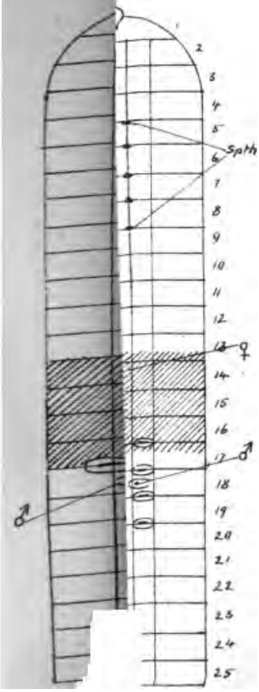


Fig 6

CRYPTODRILUS POLYNEPHRICUS



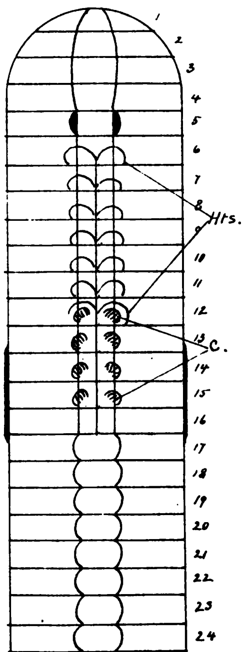


Fig 11

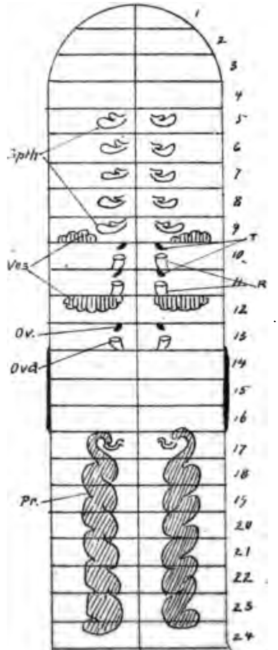


Fig 12.

CRYPTODRILUS HOBARTENSIS.

Proc. R.S. Victoria Pl. 2. 1894.

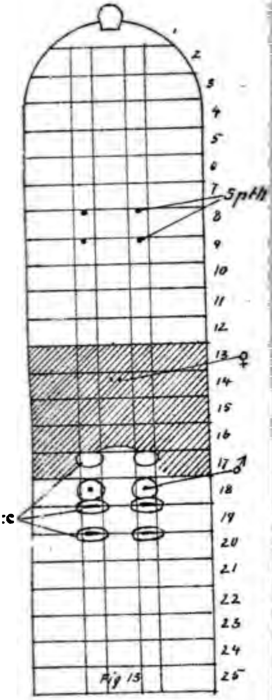


Fig 15

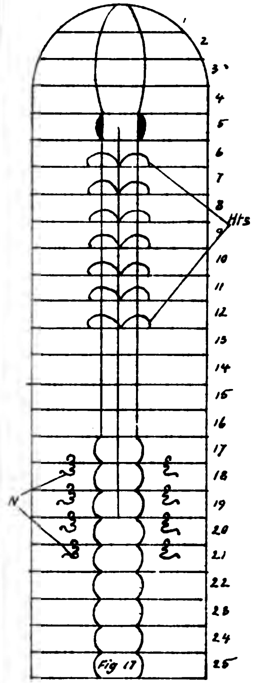


Fig 17

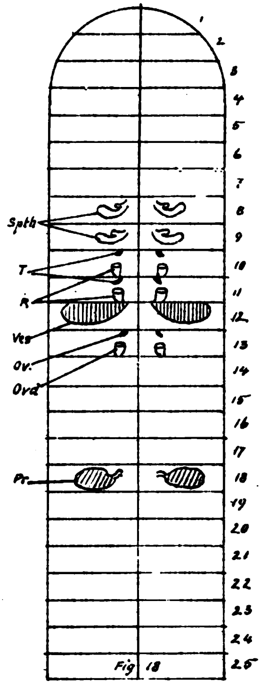


Fig 18

PTODRILUS TESSELATUS.

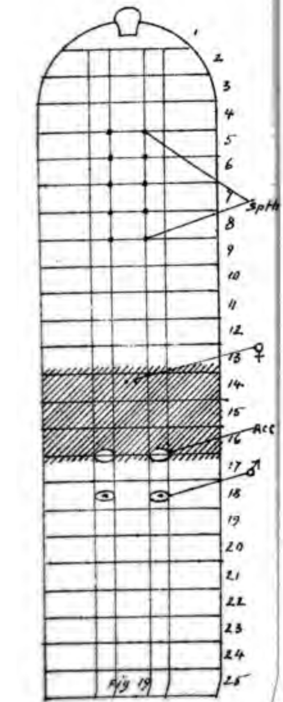


Fig 19

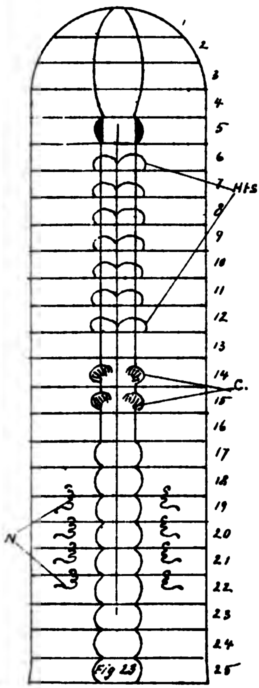


Fig 23

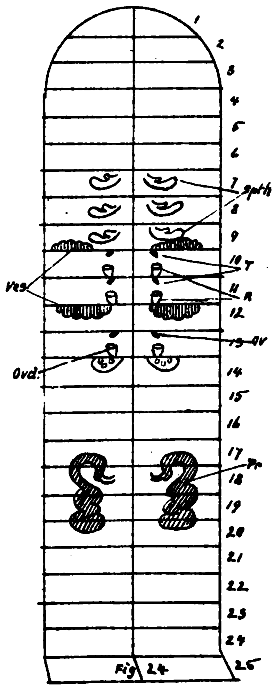
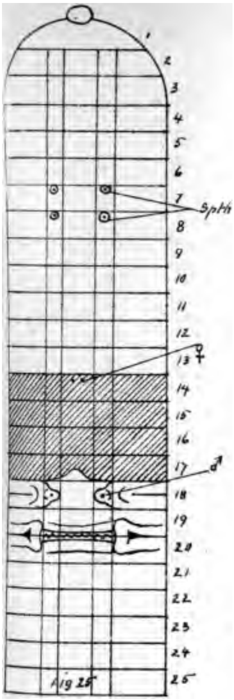
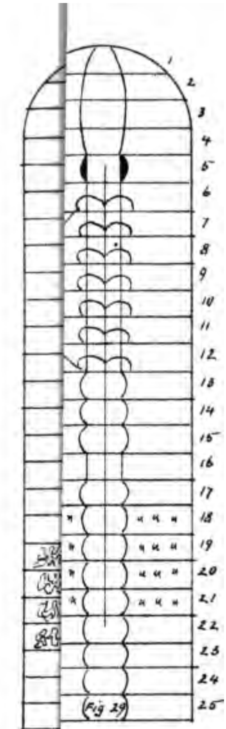
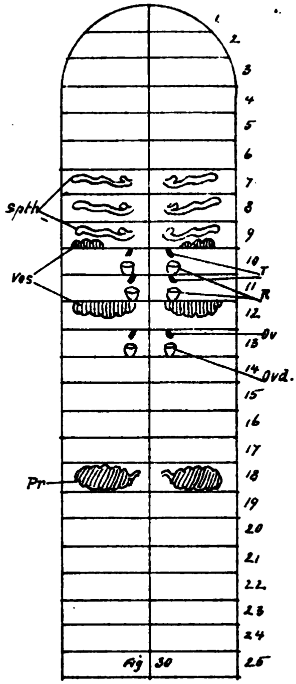


Fig 24

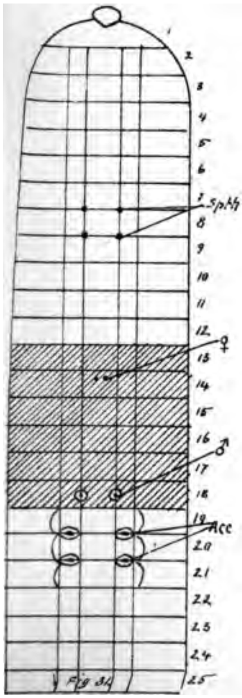
CRYPTODRILUS ELLISII.

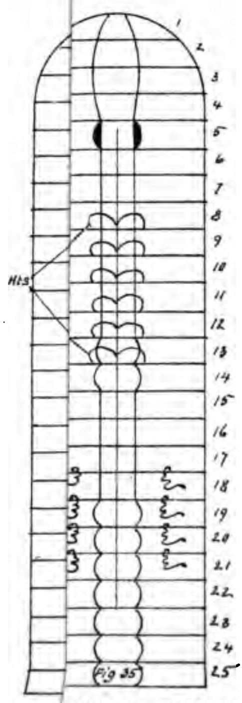


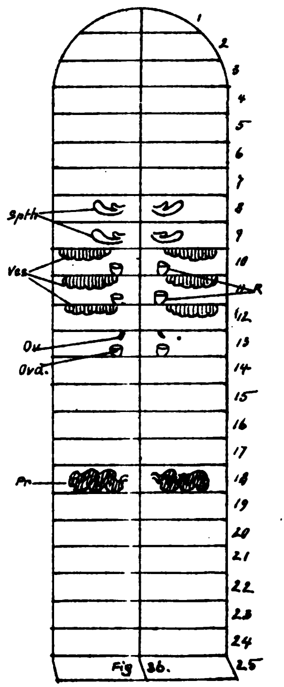




CRYPTODRILUS OFFICERI.







MEGASCOLIDES BASSANUS.

At Bradford, a few miles north of Maldon, and well within the granitic area, many interesting minerals have been found as described by Mr. Geo. Ulrich*. Mr. J. Hornsby, of Maldon, has a splendid collection of these minerals, several of the figured crystals being in his possession.

THE SILURIAN ROCKS.

Mr. R. Brough Smyth's description of the physical features of the palæozoic rocks of Victoria is peculiarly applicable to Castlemaine.† He says, "The course of the main streams nearly everywhere conforms to the strike of the rocks. The tributaries of the rivers are at right angles to them; and this system of drainage extends to the smallest basins. The configuration of the surface consequently is in many places curiously symmetrical. Running parallel with the main streams, we see two ranges of hills with subordinate ranges at right angles to them; and from every little range, oblong spaces of land, ending in low rocky prominences, run down towards the creeks."‡

Though the north and south valleys are in accord with the strike of the rocks, they show no constant agreement with the position of anticlinal axes, but, as we should expect in beds of such varying texture, scoop their courses out of the softest rock, and may work east or west towards its dip. Consequently the ridges are usually of sandstone, and as the gullies are steep-sided, an accumulation of loose blocks on the slopes and in the bottoms of the valleys occurs, and is apt to produce an impression that arenaceous beds form almost the whole of the series.§ The cause of the east and west valleys is probably to be found in jointing. The long west bend of Forest Creek, below Chewton, does not occupy a fault, as the anticlinal line passing through Monument Hill can be traced for a long distance to north and south, and shows no displacement near the creek.

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* Exhibition Essays, 1886; also Contributions to the Mineralogy of Victoria, 1870.

† Goldfields and Mineral Districts of Victoria, p. 42.

‡ See also Smyth Ex. Ess., 1866, p. 6.

§ Mr. Wm. Nicholas, during a series of lectures delivered in Bendigo, says, "in Castlemaine sandstones preponderate." These valuable lectures are reported in the *Bendigo Advertiser*, *Independent*, and *Evening News*, between February 11th and August 26th, 1831.

Selwyn* and Smyth† point out that surrounding the granite area of the district, the indurated silurian rocks usually form a range of steep and rugged hills. It will be noted that the Elphinstone and Big Hill railway tunnels are through these hills, while at Harcourt and near Maldon advantage has been taken of water courses to cross the boundary.

The rocks consist of slates and sandstones of all varieties of texture. The coarsest grit observed occurs near the head of Victoria Gully about the strike of the Corporation quarry and is exposed in the race. The quartz grains are about an eight of an inch in diameter and well-rounded. A similar grit occurs on the hills north of the head of Moonlight Flat, where it projects like a rampart twenty feet in height, and is traceable for a long distance. A peculiar conglomerate occurs near the seventy-third mile post on the Bendigo railway. It consists of a fairly fine-grained sandstone, in which are embedded rounded fragments of slate. One of these fragments was seven inches long and one inch thick. A similar rock occurs half a mile nearer Melbourne, and also in the creek cutting above the Francis Ormond Mine, at Chewton. Mr. E. J. Dunn‡ records a similar rock from Bendigo. A conglomerate, noted by Ulrich, occurs in the Brewery Gully, Maldon.

Some of the sandstones show a concretionary banded colouring which has a strikingly beautiful appearance. One set of beds of this description crosses the railway line at the Chewton station, being repeated several times by folding, and is traceable north as far as Donkey Gully. The same band recurs in the cutting at Scott's Hill, a mile and a half to the westward, and possibly again in New Chum Gully. Quartzites occur plentifully, usually in rather thin bands, and quartzose rocks which approach them in character, but are ferruginous, are common all over the field.

The argillaceous rocks are all more or less cleaved, and I have consequently classed them merely as slates. Mica is rarely present in the slates, though frequently so in the sandstones, some of the latter being thickly spangled with plates of a whitish variety of that mineral.

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* Parl. Papers, and Geol. Mag., *loc. cit.*

† G. F. and Min. D. Vic., p. 70.

‡ Rep. Bendigo Goldfield, p. 6.

As we approach the granite traces of metamorphism become more pronounced. Flaggy sandstones and quartzites are well-developed, while the more argillaceous beds exhibit the appearance of knotted or nodular slates *(fruchtschiefer).* The bye-wash of the Expedition Pass reservoir displays a fine section. The rocks here are more than usually contorted, and vertical as well as horizontal sections can be seen showing clearly the effects of "pitch," or dip of an anticlinal axis. The nodules of these slates are rarely more than an eighth of an inch in length, and frequently smaller. They are sometimes harder, sometimes softer, than the surrounding rock, usually they differ in colour from the matrix and have the appearance of carraway seeds embedded in the stone. One specimen from here showed white crystals, probably of andalusite. I have not seen any true mica schist.

Judging from the notes on the quarter-sheet (9 N.W.) a somewhat metamorphic band runs far to the south between Taradale and Fryers. The ranges on this band are very rugged, and form a part of the spur of the Divide, which Brough Smyth alludes to as running north from the Blue Mountain through Mount Alexander.

The dense, blue quartzitic sandstone of Maldon is called "Hornfels," by Ulrich. Locally, it, like a softer rock from Castlemaine, is known as "bluestone," and is used for road metal. Owing to its brittleness it is far inferior to the softer but tougher basaltic "bluestone" which is used elsewhere.

The building stone of the district, a soft brown argillaceous sandstone, is of a very variable character and blocks of good quality are a rarity. The older buildings are in a ruinous condition from the exfoliation of the stone, brought about by the decomposition of disseminated pyrites. It is quite unsuited for ths purpose to which it is applied, though unfortunately the new bridges over the creeks are built of it.

Cone-in-cone structure is rare in the rocks, and the only good specimen I have seen was in sandstone, and not in the usually quoted carbonate of lime or of iron. The specimen was found by Mr. James Shugg near the Devonshire Mine, and subsequent search has failed to bring any more examples to light. I found a peculiar example of an allied structure near the Chinese Joss

House, below Patterson Bridge. The surface of the rock, an olive slate, was closely covered with flat oval depressions about one-fourth of an inch in diameter. In some cases, on these depressions were seated small cones about one-eighth inch in height, of a whitish colour, finely transversely striated and longitudinally more deeply gooved, and having somewhat the appearance of sessile barnacles. The flat bases were downwards, and on the cleavage planes. The apices of the cones were embedded in a softer clay, and as no trace of obverse cones was visible the name cone-in-cone will not apply. The structure is undoubtedly not organic, and Mr. Newberry, to whom I sent a specimen, submitted it to Mr. Howitt, who informs me that he considers it to be of a concretionary nature. I have seen several less perfect examples, where the cone bases if not carefully examined would perhaps be considered rain-prints, and from the cleavage making the depressions deeper on one side than on the other the direction of the wind would doubtless be inferred.

Some of the blue and grey slates are thickly marked with red oval patches, mainly on the cleavage planes. Frequently a small speck of limonite in the centre shows that a grain of pyrites has yielded the colouring matter which has spread out through the rock in the easiest direction. Small oval films of pyrites were also observed in slates at the Devonshire Mine, which on decomposition would yield the same appearance.

Limestones are apparently absent, though Mr. Dunn* records a narrow band of black limestone from similar rocks at Bendigo. The presence of lime in the beds, is shown by the occurrence of strings and patches of magnesian limestone, in joints of the slates near Patterson Bridge, and at the south end of the Barker's Creek slate quarry. The frequent occurrence of calcite and allied lime-bearing minerals in the quartz veins points to a similar conclusion.

Slaty cleavage, as before mentioned, is strongly developed all over the district, and has a strike coincident with that of the beds. Over the western part of the field, the dip of the cleavage is about 80° to the westward, but whether this direction holds for the Maldon side of the district, I cannot say. In the railway cutting, on the Elphinstone side of the tunnel, the quarter-sheet

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* *Op. cit.*

has the cleavage marked at 50°. After a careful examination of this section, I feel bound to conclude that the bedding and cleavage have been confused, as the bedding is clearly seen throughout the whole length of the cutting, and that the usual high angle of cleavage is maintained. Cleavage is rarely well shown in the immediate neighbourhood of anticlines and synclines. The rocks tend to become rubbly and frequently a system of close set radial joints is developed. These joints are well displayed in many of the railway cuttings; for instance, in a syncline 200 yards west of the Elphinstone tunnel. Mr. E. J. Dunn* regards this structure as cleavage, and states moreover that the direction of the dip of cleavage varies at Bendigo, but that an easterly dip is more common than a westerly one.

There must of course, in such contorted beds as we are dealing with, be places in which cleavage and bedding coincide, but I have met only one instance of such. This is in the Barker's Creek slate quarry, where the beds dip westerly at more than 85°. Mr. Reginald Murray† says, when speaking of our silurian rocks, that "stratification and cleavage are generally identical, but cleavage distinct from stratification is not uncommon." Ulrich‡ states that the cleavage "frequently very nearly coincides with the planes of stratification." As I have searched for graptolites all over the district, the divergence of cleavage from stratification has been brought home to my mind very strongly. When the two differ much in direction, as when the beds dip east and cleavage is strongly developed, a long time has frequently to be spent in search of indentifiable fossils, till by chance a specimen is found the long axis of which accords with the strike of the rocks.

Jointing is of course usual, and well developed, in most of the sandstones. Owing to the joints being close, large blocks of stone are rarely obtainable, and frequently the sandstones are rubbly. Occasionally, as shown at the east end of Lyttleton Street, the joints are so well and evenly developed that the arch appears to be built of masonry.

Faults.—Strike-faults, as seen in the cuttings are very common,

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* *Loc. cit.*, p. 14. † Geol. and Phys. Geog. Vic., p. 41.

‡ Catalogue of Rock Specimens in Tech. Mus. Melb., 1875. Printed in Parliamentary Papers, and also issued separately).

and a small thrust-plane is shown on railway line just to the east of the Ten Foot Hill bridge, the amount of displacement being about four feet. Dip-faults I have not detected on the surface. By the miners they are known as "cross-heads," and frequently cut off the reefs or quartz veins. Diagonal faults, or "counters," "caunters" or "quonters," as the miners call them, also occur, and in some cases, as in the "No Name Reef" to the south-west of the Crown Nimrod Mine, are occupied by auriferous quartz veins. Slicken-sided rock is plentiful, and I have found well-polished faces of quartz from fault walls. The quartz veins usually occupy faults which generally have opened along the bedding planes. In the creek, to the east of Mr. James Newman's house, a block of sandstone contains small seams of slate and in these slates are many small seams of quartz, which have formed between the cleavage planes, and do not pass into the uncleaved sandstone. Selwyn* states that the large quartz reefs often occupy a similar position. "Saddle-reefs," such as occur at Bendigo, appear rare, and but few reliable instances are recorded. These reefs (formed as Mr. Wm. Nicholas, Mr. E. J. Dunn, and others have minutely described, in cavities produced on the anticlines by the unequal bending power of the various rocks) which are the source of the greater part of the Bendigo gold, are frequently reported in this district from the most impossible places. One mine in particular, during my residence in Castlemaine, reported having struck a "west-leg" of such a "formation" and were cross-cutting east to strike the other leg, which they professed to expect at a very short distance, while, as a matter of fact, the anticline on which alone such a reef could be formed lay at a distance of over 300 feet away. Fortunately, of course, gold occurs plentifully in reefs which are not "saddle-reefs," and "saddle-reefs" are just as likely to be non-auriferous as any others. A small "saddle-reef" was struck in the Ajax mine on the anticline about sixty feet east of the shaft, and another occurs on the Daphne reef anticline in Lost Gully. Many of the mines of the district are near anticlines, but quite as many, if not more, are far from them. As an example of the former, we may note the Devonshire mine, and the eastern shaft

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* Ex. Ess., 1866, p. 13.

of the South Wattle Gully Co.; while the once fabulously rich mines on the other side of Wattle Gully, are as near to a syncline as to an anticline. The Bolivia reef occupies a fault with a western hade, the country rock dipping east. The country in the neighbourhood of quartz reefs is usually so disturbed that observations of dip are unreliable in these localities.

Rock folding.—The whole series of rocks is much folded and crumpled. Hand specimens may be gathered which show the folding on the most minute scale and such crumpled rock generally occurs near the axis of one of the larger anti- or synclines. To this puckering, I feel constrained to put down most, if not all the instances quoted, of "ripple marks" in our silurian rocks. Two such instances may be noted. Mr. E. J. Dunn* speaking of the Bendigo "saddle-reefs," describes the rock slipping that must have taken place during their formation,† and then notices that one wall of the original cavity shows ripple-marks beautifully developed, that is, just at the place where rock-slipping must have been greatest. The other instance occurs in the bed of the Moonee Ponds Creek, near the Park Street bridge. In this case also, there has been considerable rock movement, for the bed which shows the marks is about eighteen inches below a thrust-plane, which is accompanied by shattered rock, and small veins of quartz. Innumerable other instances may be quoted, but when we are dealing with rocks like those of Castlemaine, which have an average dip of over 70°, or of Bendigo with one of 65°, the simplest explanation seems to be that the structure is a form of crumpling, for were it otherwise, its observance would be a rarity instead of one of the commonest of occurrences.

The larger anticlines succeeded each other very rapidly, the average distance being 300 yards. In the water-race from Chewton to Castlemaine, along the hill slopes to the south, I have plotted thirteen in two and a half miles. This agrees closely with what occurs at Bendigo.‡ The anticlines can be traced for long distances. For instance, I have traced the anticline through Monument Hill for two and a half miles. The anticlines have a fairly constant strike of N.5°W. Owing to the way in which

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* *Loc. cit.*, pp. 6 and 12.

† See also Wm. Nicholas, F.G.S., in *Bendigo Advertiser*, and *Bendigo Independent*, August 27, 1881, for similar explanation.

‡ Dunn, *loc. cit.*, plan.

they die away and are replaced by others, the folds may be compared more with sea-waves than with anything else. The Ajax anticline may be taken as an illustration. A well-marked anticline may, as before mentioned, be seen about twenty yards east of the shaft, the strata dipping east and west for some distance from the axis. This axis may be traced, with but a small intermission, caused by a gully crossing it, as far north as the Maldon railway line. Here, as shown in the cutting, it has almost disappeared, and is merely represented by a slight roll in the strata, the main dip being westerly. Still further north, in the cutting in front of the Church of England Parsonage, its only trace is a crumpling of the slates. The anticline to the eastward is now the main one. Near the Ajax it is scarcely, if at all, noticeable. Its axis is shown at the south end of Barker Street, and it passes through the Corporation quarries in Bull Street, near the railway line, and it is now an important fold.

Besides this dying away of anticlines, it is of course the rule in disturbed rocks that the axes of the folds are rarely horizontal. Owing to the peculiar structure of the Bendigo "saddle-reefs," and the great extent of the underground workings, Mr. Dunn and the mining surveyors have been enabled to work out the "pitch" or dip of the axis very thoroughly. Similar facilities do not occur in Castlemaine, but in a few instances the top of an arch is sufficiently bared to enable observations to be taken. The most striking example I know occurs near the head of Sailor's Gully,* the gully next to the north of German Gully. (The exact spot is a few yards west of a quartz reef, as shown on the map, crossing the valley). At first sight it appears like a dip-fault, as two parallel bands of sandstone occur with a strong outcrop. In reality, however, they belong to distinct beds, and their disappearance north is caused by a "pitch" of about 40° and the bands curve round as they "nose-in" on the flat. This is the highest "pitch" I have noted, but Mr. Dunn records one of 60.°† As attention has only recently been called to the effects of pitch on the structure of our goldfield areas by Mr. Dunn, perhaps a few localities had better be recorded where it can be studied in this district. The anticline at the east end of Lyttleton Street pitches 13° to the southward; another on the east side of Wattle Gully,

* ¼ S., 13 S.W. † *Loc. cit.*, p. 12.

about 100 paces south of the S. W. G. Co.'s eastern shaft, pitches 12° N.; another, south of the Campbell's Creek Road, just above where Dead Horse Gully joins the creek, pitches 12° N. and is a fine example. Mr. H. W. Green, legal manager of the Ajax Co., read me the mining manager's reports for 1890, from which it appeared that the anticline previously noticed in that mine carried at the 900 feet level a small saddle-reef. This was "driven on" north, for some distance, and, after undulating slightly, finally took a strong northerly pitch and passed underfoot. Out of a total number of eight instances, in which I have recorded pitch in my notes, seven showed a northerly inclination, and the palæontological evidence seems to point to a general northerly pitch of all the rocks to the east of Castlemaine. Professor J. D. Dana* points out that in order to get a thorough knowledge of the pitch of strata in any disturbed district, thousands of dips must be accurately plotted, a labour from which, for many reasons, I have shrunk.

Dip.—Over the eastern portion of the district, from Barker's Creek to the granite, there are numerous good exposures and dip can easily be observed. From Elphinstone to Chewton the railway cuttings give an almost continuous section; while from Chewton a water-race extends along the hill-sides as far as the Ajax mine. To the westward of Barker's Creek the country is more deeply masked by surface soil, the gullies are fewer and of less importance, and the scrubby timber is thicker, so that I was unable, after several futile attempts, to make any satisfactory number of observations. The Maldon railway line has such shallow cuttings that, for that part of the field, I have had in great measure, to fall back on the recorded observations of others. In railway cuttings, where nearly vertical beds are cut obliquely to their strike, the slope of the cutting gives an apparent dip in different directions on opposite sides, and on hill-slopes especial care must be taken, as surface slipping renders all observations except on a north or south slope of little value.

From Elphinstone, nearly to Chewton, the dip, owing to constant inversion is westerly, and the bending over of the beds can be well traced in many places. In the deep cutting at the west end of the tunnel a fine anticline is displayed in grey

* *Nature*, vol. xlvi., p. 164.; also Amer. Jour. Sci., June, 1892.

sandstone, and is best seen from the top of the cutting on the south side. East of the anticline the beds dip more and more steeply to the east, and at about thirty paces have completely turned over, and dip west. The syncline near the drain, about 150 yards west, behaves similarly, so that a constant westerly dip holds throughout the cutting. The next cutting to the west is still more interesting. It is 350 yards long, and about thirty feet deep for most of its length. An anticline occurs 180 yards from the west end, and, as the rocks are shattered in its vicinity, some care is requisite for its detection. For a few yards east of the anticline the beds have a high easterly dip, then become vertical, and finally turn over with a westerly dip of about 75°, which is maintained to the end of the cutting. The variations in the texture of the beds are great, but, speaking generally, the rocks grow finer as we ascend, and pass from grits to fine grey slates. All the beds are repeated, so that a band of graptolitic slate recurs at each end of the cutting. Fossils were extracted with difficulty, and are badly preserved. Among the forms were *Didymograptus bifidus*, *Tetragraptus bryonoides*, *T. caduceus*, *Goniograptus sp.*, *Phyllograptus* several forms, *Dendrograptus sp.* and *Lingulocaris M'Coyi*, the horizon being thus clearly shown. The inversion can be clearly traced in several other cuttings, and in the creek sections towards Chewton, but none are so well-marked as this.

The quarter-sheets do not show that the great amount of inversion here displayed was detected. The only indication of any overturned beds that I can find is given on ¼ S., 9 S.W., near the south-west corner, where a brief note records its occurrence. This locality is nearly on the strike of Chewton and Fryers. I may say that it was on palæontological grounds that I suspected the inversion, as the succession of the graptolites was not in accord, apparently, with that near Castlemaine. From Wattle Gully to Castlemaine the beds are less disturbed, and the anticlines are more easily detected. A series of about seventy observations gave an average dip of a little over 70°, there being no marked difference between the amounts of easterly and of westerly inclination, though the general dip is westerly. How far this general westerly dip extends I cannot say. From my own, admittedly imperfect, observations, I had put the main syncline

down as about a mile and a half west of the town. Selwyn and Ulrich both state the general dip about Maldon to be easterly, and the former has placed the syncline further west near Muckleford Creek.

In a mining district, where everyone is a geologist, it is unfortunate that the geological term "dip" should be, as here, misused, and still more, used in a different sense in Castlemaine from what it is in Bendigo. The strike of our silurian rocks, both upper and lower, is constantly nearly north and south, so that in a mine we generally have two sets of workings. One set ("drives") agrees with the strike, and the other ("crosscuts") with the dip joints. Any bed or vein with an east or west inclination is said to "underlie" or "underlay," while any north or south inclination of a vein or dyke is called the "dip" at a given rate. The distinction has, of course, a practical value, or it would not be used. In the Bendigo "saddle-reefs" the miner's "dip" is the geological "pitch." In Castlemaine, a vein with a north-east dip would be said to "underlie" east and "dip" north, the true dip being resolved into two directions at right angles.

The Graptolite Succession.

Mr. G. H. F. Ulrich, in his valuable catalogue above quoted, states that "owing to the absence of distinctive beds, such as conglomerates and limestones, together with the fact, that the same genera and species of graptolites occur throughout the lower silurian series, no means at present (1874) exist for subdividing the formation." On first examining the graptolites in the immediate neighbourhood of Castlemaine, I was at once struck by the difference of the facies from the one I was already familiar with at Bendigo, and a closer examination of the district showed that there was a gradual change in the character of the fauna on going eastward. This discovery was, of course, only made after many long walks and fruitless searches for fossils amongst the rugged hills that surround the town. The spoil heaps of the gold workings, which lie in every direction, are for the most part old and weather-worn. Pyrites, and other easily decomposable minerals, have aided in the work of destruction, and it is consequently an exception to find graptolites in

these localities, sufficiently well preserved for recognition. Even when, after long practice, I was able to judge that a certain outcrop would yield fossils, a couple of hours work with the pick, often not only showed the correctness of the judgment, but also that cleavage and weathering had almost entirely destroyed the characters of the specimens. Ultimately, however, a few localities were found, from which a fair number of species were procured. The change of fauna from east to west has already been alluded to, but the work of correlating the scattered outcrops at first presented great difficulties, as they were dotted irregularly over six or seven square miles of rugged country, and I was uncertain which were the upper and which the lower beds. Fortunately my first systematic attempt was completely successful, and, as I suspected from the general westerly dip, the beds south of Chewton were the lowest. I chose an outcrop at Daphne Reef in Lost Gully, as my starting point. Here, almost on the summit of an anticline, a small excavation yields forms identical with those of the central part of Bendigo. The commonest and most characteristic form is *Tetragraptus fruticosus*. This occurs of all sizes, and some of my specimens quite dwarf all illustrations I have seen. The branches, after the outward curve, run in a straight line, and the form has the appearance of *Didymograptus V-fractus* (Salter), but its true tetragraptid nature is clearly shown in several specimens. In one example from this locality, one branch is over eight inches in length, and is broken at the distal end. I have similar specimens from Bendigo, but none so large. The anticline was traced over very rough ground, north, for three-quarters of a mile, and *T. fruticosus* was found all the way, till I found myself in Wattle Gully, to the west of another good locality. Owing to the steep slope of the ground the last part of the work had been very difficult, and I spent over an hour breaking slate, before I found the required specimen of *T. fruticosus*. This zone, the *T. fruticosus* zone, is 200 feet below the next above. The intervening rocks are clearly shown in the race, to the south, but yielded no fossils after several visits.

The second zone, just mentioned, which I worked principally from a small shaft in the South Wattle Gully Claim, is characterised by the extreme relative abundance of *Didymograptus bifidus*, which apparently ranges no higher, though it occurs

rarely in the zone below, and I have specimens from Bendigo and Tarilta on the same slab as *T. fruticosus.* I have found five outcrops of this, the Wattle Gully zone, namely, two previously mentioned near the Elphinstone tunnel, one to the south of the head of Poverty Gully, one near the head of Kampf's Gully, and this one in Wattle Gully. The Kampf's Gully outcrop is near a syncline which was traced south to near the Eureka reef, when the same relation to the *T. fruticosus* zone was again observed. A specimen of *Dichograptus octobrachiatus*, with a central disc, was secured from the lower zone at this locality. The only other specimen of this variety I found at Burns' Reef in a higher zone, and it has not hitherto been recorded for Victoria.

I have not been able to accurately trace the relationship of the Wattle Gully zone, to the next above, as a considerable thickness of sandstone intervenes, and is exposed both to the east and the west of the Chewton anticline. To the east of the head of Victoria Gully, at Nicholson's Reef, in Dog-leg Gully, and at Burns' Reef fossils occur, which I believe belong to the same horizon. There are no well-marked forms especially abundant, but the beds may be distinguished from those below by the absence of *D. bifidus*, and from the zone above by the still comparative rarity of *Tetragraptus caduceus*. In default of a distinguishing species, I have called this the *Burns' Reef* zone, from the locality where I found the best exposures. At this place a thickness of three hundred feet of unfossiliferous concretionary-banded sandstone, and slate, separates it from the zone above.

This upper zone is characterised by the relative abundance of *Phyllograptus* associated with *Tetragraptus caduceus* (Salter). The former genus is abundant throughout all the beds, from this horizon downwards, but though plentiful in this zone is not found above it. *T. caduceus* ranges throughout all the Castlemaine rocks, being rare in the lowest beds, but gradually increasing in numbers and in size at the same time, as we go upwards. In the *T. fruticosus* zone it is rare and small. It is but slightly more abundant in the Wattle Gully beds, and it is not till the present horizon is reached that it becomes a dominant form. I have called this the *Phyllograpto-caduceus* zone, a useful though perhaps awkward term.

From the outcrop mentioned, west of Burns' Reef, I have traced this zone in a northerly direction as far as Donkey Gully, where it is found passing to the west of the Crown Nimrod shaft, a distance of a mile and a quarter. Another outcrop occurs in Deaf Ben's Gully, a mile to the south of Burns' Reef, but not on the same strike, as the beds repeat to the east. Another outcrop occurs in the railway cutting, twenty paces west of Ten Foot Hill Bridge, and is traceable in a southerly direction for about a mile. At the head of Victoria Gully it is found to overlie an outcrop of the Burns' Reef beds, being separated from them by a thickness of about 230 feet of sandstones and coarse grits. An outcrop is also seen on the east side of New Chum Gully, close to the Ajax anticline.

The next zone is a well-marked one. *Tetragraptus caduceus* occurs in the greatest profusion; I think fully eighty per cent. of the specimens belong to this form. Several good exposures occur, and a great part of my earliest collecting was done on the various outcrops of this zone. *Phyllograptus*, as before mentioned, has disappeared, while immediately below it is fairly abundant. One or two species of *Diplograptus* occur somewhat commonly, though rare below this horizon, together with several species of *Didymograptus* and one of *Dichograptus*, which I have not yet identified with certainty. In Victoria Gully, where a spoil-heap from a small mining shaft on the east side of the gully yielded a good collection of forms, I was able to measure the thickness separating this zone from the one below, and found it about 250 feet. This estimate was checked in the railway cutting about half a mile north, and the results were in accord, as I measured the distance west of the *Phyllograpto-caduceus* zone, and found the *T. caduceus* zone at the required spot.

The next zone contains *Loganograptus Logani* associated with numerous examples of *T. caduceus*. An outcrop occurs at the head of John o' Groat's Gully, being separated by a thickness of 300 feet from the *T. caduceus* zone below, both occurring on the same side of the same (Ajax) anticline. It is on the strike of the eastern limb of this anticline that Professor Sir F. McCoy records *Loganograptus* from Barker Street, Castlemaine. As far as I can learn the spot was in front of the Mechanics' Institute, and is now inaccessible; but in a yard behind one of the shops I

was able to obtain evidence of the existence of the *T. caduceus* zone with a dip to the east. From this evidence I looked for and found *L. Logani* a mile to the south as above indicated. *L. Logani* is abundant in this zone, and I have a doubtful fragment from the zone below.

This species has been confounded with two others from which it, however, is quite distinct. In its method of branching it is truly dichotomous, excepting as an abnormality, when a branch is occasionally suppressed, and the branches arise at no great distance from the centre. The genus with which it has been confused is *Goniograptus* (McCoy), in which true dichotomy does not occur, but as described by Professor McCoy,* each of the four main branches is angularly bent, and from the salient angles secondary branches are given off, which alone are celluliferous. A branch stripped of its hydrothecæ would have the appearance of *Thamnograptus*. *Goniograptus Thureaui* (McCoy), the type of the genus, has about forty-eight branches, is rather rare, and is confined to the *T. fruticosus* zone. Another species has from twelve to sixteen branches, and is common in the same zone but occurs, though rarely, as high as the Burns' Reef beds. An examination of a large number of specimens of the latter species leaves no doubt in my mind that it is congeneric with *G. Thureaui*, but specifically distinct. Herrman† describes and figures a species as *Dichograptus Kjerulfi* which has a similar aspect to the present form. I have not seen the central disc he describes, and the constant differences in the number, form and arrangement of the hydrothecæ show that our form is distinct from Herrman's. The method of branching is so striking in McCoy's genus that, in spite of Herrman's objection, I think it should stand, and, moreover, that Herrman's species should rank under it. The horizon he quotes for Sweden, is *Lower Phyllograptus shales*, just where it occurs with us, and there, as here, it is not associated with *L. Logani*. Mr. R. Etheridge, Junr.,‡ figures two examples which he calls *L. Logani*, but both are evidently referable to *Goniograptus*, the characters of which had not then been pointed

* Prod. Pal. Vic., Dec. V., pl. 50, also A.M.N.H., vol. xviii. (1876), p. 129.

† Geol. Mag. 1866, pp. 13, *et seq.*, transl. and abrd. by W. S. Dallas from Nyt. Mag. for Naturvid, vol. xxix.

‡ A.M.N.H., vol. xiv., 1874, pl. iii., figs. 11 and 12.

out by Professor McCoy. Fig. 11 is apparently *G. Thureaui* and fig. 12 is this new species. Etheridge, moreover, amongst other associated forms, quotes *Phyllograptus typus*, a genus which in Victoria does not range as high as the *Loganograptus* zone and *Didymo. Pantoni* (McCoy, M.S.). This latter species Professor McCoy* says is identical with Hall's *Tetragraptus fruticosus*, an identification which is frequently overlooked. Sir Frederick McCoy also records *L. Logani* from Newham,† but an examination of the specimens in the National Museum, on which this record was presumably founded, shows that they have the aspect of *G. Kjerulfi*, and the non-occurrence of *Loganograptus Logani* at Bb. 29 is also shown by the fact that *Phyllograptus typus* is also quoted by the Professor from the same locality (Bb. 29). In fact it appears that Bb. 29 is on an outcrop of the *Tetragraptus fruticosus* zone. Herrman‡ also seems to have considered the two forms as identical at one time, but to have subsequently altered his opinion. Having regard to the different horizons of the two forms, the importance of distinguishing them will be manifest.

Above the *Loganograptus* zone, my detailed observations do not extend. To the westward of Castlemaine, fossils are very scarce, a single specimen of *Phyllograptus* was gathered by Dr. Dendy, in my company, on the strike of about 200 yards west of where I have noted the occurrence of the *Loganograptus* zone, and a few specimens of *T. caduceus* from the same and other localities are almost the only identifiable fossils I have seen. The difficulties attending their discovery here, have been noted above. In his notes on the Maldon sheet, Ulrich states that the only fossil found in the silurian rocks of that district was a single specimen which he quotes as *Hymenocaris vermicauda* (Salter). Possibly this is the ubiquitous *Lingulocaris McCoyi* (Eth., Jun., = *Hymenocaris Salteri*, McCoy, M.S.). Mr. Norman Taylor also mentions§ that he has found no graptolites in the country immediately south of the Maldon strike. From Daylesford, however, twenty miles south on the same auriferous band, we find graptolites in profusion, and a small collection in the possession of Mr. John Hammerton, of Geelong, the only ones from there

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* Prod. Pal. Vic.

† Bb. 29, in Prod. Pal. Vic., Dec. 1, p. 19.

‡ *Loc. cit.*

§ Rep. Min. Surv. Vic., Dec., 1888, p. 70.

which I have seen, contained the characteristic species of the *Tetragraptus fruticosus* zone. I cannot help feeling that the same zone will be found at Maldon, though the highly metamorphic character of the rocks will make the discovery of fossils difficult. My last excursion before leaving Castlemaine was made with a view of carefully searching the railway cuttings on the Maldon side of Muckleford Creek. The first likely-looking spot after leaving Maldon, however, was found only nine and three-quarter miles from Castlemaine. Graptolites were found on the first trial, but unfortunately were so decomposed that I could not identify them. Numerous small crustaceans, possibly *Lingulocaris*, also occurred. This was the only place where fossils were obtained, though the country near Fentiman's Reef would, I think, repay further search.

The Graptolites of other Localities.

The careful way in which the localities of specimens were recorded on the maps, by the officers of the old survey, and the references to those localities by Professor Sir Fredk. McCoy, in his "Prodromus of the Palæontology of Victoria," enable us to make some interesting comparisons, and, at the same time, cause us to wish that we had further elucidations of the hieroglyphics on the maps. The fauna of the lowest Castlemaine zone, which I have observed, agrees with the beds of Bendigo in a very marked manner. The Bendigo beds which I have examined most closely are in Derwent Gully, a little below where the Carshalton anticline crosses it, and at Ironbark, just west of the Victoria Quartz Mine, as well as less thoroughly at many other spots. Mr. Wm. Nicholas, F.G.S., has given me a small number of slabs of slate from near the Old Sarnia Reef at the south of the field, and all three localities agree very closely in their fauna. The agreement of an outcrop at Daylesford with this zone has already been indicated. Besides Bendigo, Professor McCoy records *T. fruticosus* from Spring Plains (Bb. 45, Bb. 46, ¼S. 13 N.E.), the Upper Loddon on the strike of Chewton and Fryers (Ba. 76, ¼S. 9 S.W.), and a couple of miles east of Gisborne (Ba. 71, ¼S. 6 S.W.) These localities then contain beds at or near the same horizon, though doubtless it will be possible for subdivisions to be made later.

With regard to the Lancefield beds, the plentiful occurrence of highly compound forms would lead us, by analogy with the succession in localities in the northern hemisphere, to place them below the lowest of all the beds dealt with. Fortunately we have evidence of a stronger character which points in the same way. A striking slender bifid graptolite occurs commonly at Lancefield, and I have found specimens at Daphne Reef, and Derwent Gully. *Clonograptus* occurs, at any rate as high as the Burns' Reef beds in Castlemaine, but is rare, while several species occur at Lancefield. The Bendigo Museum contains a fragment labelled "Bendigo," which is apparently the gigantic species described by Mr. G. B. Pritchard as *Temnograptus magnificus* from Lancefield, where it is common. In a paper read at a recent meeting of this Society, Mr. Pritchard records *Tetragraptus quadribachiatus* from the same locality. It occurs in the *T. fruticosus* zone, is very abundant in the Wattle Gully beds, and occurs, though rarely, as high as the *T. caduceus* zone. The genus *Phyllograptus* is not represented in the Lancefield beds, but is recorded by Professor McCoy not far to the westward, and on examining the specimens from this locality, in the National Museum, I detected one or two small specimens of *T. fruticosus* on one of the slabs. The evidence then points to the fact that the Lancefield beds are below the *T. fruticosus* zone, and probably at no great distance.

The graptolitic slates of Darriwill (19 S.W.) are apparently on the horizon of the *L. Logani* zone for that species and *T. caduceus* are, according to Professor McCoy, very plentiful at that locality,* and the specimens quoted are on view in the National Museum. Graptolites are recorded from many other lower silurian localities in Victoria, but till further observations are made, and more of the species are identified, it will be rash to assume any succession based solely on that of the northern hemisphere. Probably the same general succession will hold, but it is quite likely that certain species and genera will be found to have a different range in the two regions, so that inferences based on the few recorded species for these other localities may quite possibly be erroneous.

* Prod. Pal. Vic.

In New Zealand it may, however, be noted that graptolites occur, and Sir James Hector* gives some woodcuts of species found there. These are, however, not named in the work, and the figures alone merely give general characters. All the figures might be intended for forms which occur in the Wattle Gully or in the *T. fruticosus* zone in Castlemaine, and the former is the more probable horizon.

The results obtained may be tabulated as follows, the beds being arranged in descending order:—

1. Zone of *Loganograptus Logani*, occurring at Castlemaine and Darriwill.
2. Zone of *Tetragraptus caduceus*, occurring at Castlemaine.
3. *Phyllograpto-caduceus* zone, occurring at Castlemaine.
4. Burns' Reef beds, occurring at Castlemaine.
5. Wattle Gully beds, occurring at Castlemaine and (?) New Zealand.
6. Zone of *Tetragraptus fruticosus*, occurring at Chewton, Bendigo, Spring Plains, Tarilta, Upper Loddon, Daylesford, Gisborne, and to north-west of Lancefield.
7. The Lancefield shales.

With regard to the extension of the zones in the line of strike, the important effects produced by "pitch" must be recognised, as has been so fully indicated by Mr. E. J. Dunn in his "Report on the Bendigo Goldfield." There is evidently a strong northerly pitch in the great Chewton anticline, as, although I have carefully examined the area north of Forest Creek, I have never been able to find traces of any but the second and third zones. The sixth zone again occurs at Tarilta, approximately on the strike of the highest indicated zones at Castlemaine.

Auriferous Bands.—The fact that the auriferous quartz-veins of Victoria occur in fairly definite bands of country, separated by non-auriferous bands of lithologically similar strata, is one that early impressed itself on observers, and it is difficult to say who first noted the fact. Sir Alfred Selwyn records it, and Mr. Evan Hopkins† also mentions it. In a recent report of the Mining Department an old letter to the Governor of the Colony from

* Cat. Geol. Exhibit, Ind. and Col. Ex., 1886, p. 82.

† Q J.G.S., vol. x., p. 324.

Mr. J. A. Panton, then warden of the Bendigo goldfield, shows that he was one of the earliest to point out the same fact. Mr. Wm. Nicholas, F.G.S.,* has worked these bands out in great detail; and Mr. Reginald Murray† follows out the same principles. Both of these gentlemen have, since then, repeatedly called attention to these facts as an aid to future mining operations. In the Castlemaine district the main auriferous band strikes through Fryers and Chewton, and is approximately on the same strike as the richest portion of the Bendigo field. In the former district the band is seamed with reefs that have yielded almost fabulous quantities of gold, and most of the auriferous gullies head to this line. The chief apparent exceptions to this last fact are those gullies which receive the drainage of gullies cutting through the older gravels. As we go westward from this line, and travel over higher beds, the rich reefs grow fewer and fewer, and we have no well-marked lines like the one mentioned. When we reach, what Selwyn states to be the highest beds of the district, on the meridian of Muckleford Creek, the quartz-reefs are apparently more numerous than ever, but the richly auriferous country-rock is not there to feed them, and they are barren. The quarter-sheets show that nearly every gully in this locality was carefully searched for gold by the survey party, but without result, and this for miles to the north and south. Since then the Mining Department has, by a carefully chosen series of bores, tested the deep ground of Muckleford Creek, but with a like negative result.‡ In the Lancefield rocks again, no gold occurs. It appears then, that the auriferous strata of our lower silurian rocks begin above the base of the apparently thick *T. fruticosus* zone, and range, at anyrate, as high as *Phyllograptus* does, but probably no higher. That the recurrence of the auriferous bands across the colony is due to the recurrence of the same sets of beds, is so very probable, that the idea is the common property of geologists, but no attempt has, I believe, been previously made to show how these beds might be distinguished.

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* Prog. Rep. Geol. Surv. Vic., vol. iv., p. 145.

† Geol. and Phys. Geol. Vic., p. 157.

‡ Ann. Rep. Sec. Mines, 1890.

Thickness of the Strata.—Sir Alfred Selwyn* gives a section, before noted, passing through Mounts Alexander and Tarrengower, and on the evidence of this, states that the thickness of the silurian rocks of *this district* is not less than 35,000 feet. To get this thickness on this line of section, and with the average dip he gives, no allowance can be made for repetition by folding. I cannot find that he ever gave reasons for altering his opinion on this point, but we find him in 1861 (Ex. Ess., p. 177), and again in 1866 (Ex. Ess., p. 11), applying these figures to the whole of the upper and lower silurian rocks combined. This, his more recent statement, has been generally followed and quoted. Now the west end of the silurian trough of his section is nearly on the strike of the Chewton anticline, where it runs into the granite; so that perhaps he could have calculated the true thickness of the Castlemaine series along his section line, though, from the indications of a northerly pitch, I do not think so. Since the days when Selwyn made this traverse of a difficult and practically unexplored country, and without suitable maps, great changes have taken place. Railway and road cuttings, water-races and mines have given facilities, that he was without, for examining the rocks.

The lowest beds, as shown by the presence of *T. fruticosus*, crop out near the west end of the Elphinstone tunnel, so that we have here an anticline, which, though auriferous west of Taradale, at Drummond and Lauriston, some miles to the south, is very poor in quartz-reefs, and apparently non-auriferous at this locality. A slight syncline occurs to the west, at about the meridian of the seventy-fourth mile post on the railway line, though the highest zones are missing. The crest of the next great anticline runs, as before stated, through Chewton. Selwyn places the main syncline between Castlemaine and Maldon, about Muckleford Creek. Taking this last observation of his as correct, we can calculate the thickness approximately. From the Eureka Reef, where an outcrop of the *T. fruticosus* zone occurs, to the west end of John o'Groat's Gully I have plotted all the anticlines and synclines I could detect. In this distance (two and one-eighth miles) I find:—

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* Parl. Rep., *loc. cit.*, and Q.J.G.S., vol. x.

The total amount of westerly dip shown is	2376	yards.
„ „ easterly „	1364	„
„ excess of westerly „	1012	„

The mean of sixty-seven observations of dip is a trifle over 70°. If we assume this excess to be constant as far as Selwyn's syncline, and assuming the dip to be, as I believe it is, at the same rate, we get in five and a half miles an excess of 7858 feet of westerly dip exposed, which is equal to a thickness of 7500 feet. If we add 500 feet for the probable thickness exposed below the Wattle Gully beds, we may put down the total thickness of the lower silurian rocks exposed in *this district* as 8000 feet. As yet we have no means of even guessing the total thickness of our lower silurian rocks, and of the thickness of our upper silurian we know nothing.

Newer Rocks.

The only other sedimentary rocks of the district are the old and recent river gravels. Castlemaine itself is a little over 900 feet above the level of the sea, and none of the older gravels are more than 1100 feet. The latter usually occur here as cappings to minor hills, which they have protected from denudation. The linear arrangement of these hills, and frequently their relation to the present drainage system, shows them to be of fluviatile origin, and Selwyn† did not intend the general remarks he made in reference to some marine tertiary gravels to apply to this distinct, or to Bendigo, though it is often stated that he did so. Even when the relation of the old gravels to any drainage system sufficiently large for their accumulation is not apparent at first sight, the effects of denudation must be borne in mind. On this head Colonel (then Captain) Couchman, formerly Chief Mining Surveyor, makes some able and interesting remarks.* Taking most of his illustrations from this district, he shows how changes in the courses of rivers may be made, by tributary streams cutting back, and by main streams working towards the dip, till another water-shed is tapped, and the old river-bed

* Ex. Ess., 1866, p. 22. † Smyth's Goldf. and Min. Dist. of Vic., pp. 158-60.

with its gravels is left in what is, at first sight, an inexplicable position. Since he wrote, the subject has received considerable attention in the United States.*

The officers of the Survey have devoted a great amount of care to these economically valuable beds,† and have divided the gravels of this district into older and newer pliocene and recent. The evidence of the separation of the first two named, is frequently very obscure. I do not see, for instance, how the lower portion of the Forty-foot Hill deposit is classed as of the same age as that capping Diamond Hill, lower down the same stream and about eighty feet higher above sea level. The character of the deposits is described in the greatest detail by Ulrich, and it will suffice to state that all the rocks in the gravels accur *in situ* in the present water-shed, there being a preponderance of those found near the granite boundary. The indurating action of metamorphism is shown both by the range bounding the granite and by the occurrence of fragments many miles below the metamorphic zone. Slickensided fragments frequently occur, but I have not seen any examples of which could be referred to glacial action. Some terrestrial fossils are recorded on the Southern Maldon sheet from these older gravels. Amongst other specimens was an almost complete skull of *Sarcophilus ursinus*. The only organic remains I have found are a few traces of plants which were, however, quite indeterminate.

Volcanic Rocks.

Dykes of basic volcanic rock are fairly common, though very few are shown on the map, their small size and decomposed condition rendering their detection at the surface almost, if not quite, impossible. The rock contains numerous crystals of olivene and hornblende, frequently of large size. Black mica occurs in a dyke at the Eureka Reef and in one near Harcourt, at the latter place sometimes reaching three-quarter inch in diameter.‡ One dyke, six feet thick, at Burns' Reef, is traceable north for more than a mile; others occur on the west side of Wattle Gully, at the Englishman's Reef, Ajax Mine, while several are exposed in

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* Contributions to "Science," 1893, &c.

† Ulrich—Cat. Rocks, &c., p. 189, *et seq.*, and reprinted in Lock's Practical Gold Mining.

‡ See also Ulrich, *loc. cit.*, p. 35.

the railway cuttings near Chewton, and I could quote many more in the district. Lithologically, judging by hand specimens, the rock seems to resemble that of the Bendigo dykes which Mr. Howitt calls Limburgite.* At Maldon, in the Eaglehawk Mine, a beautiful green dyke-stone occurs containing massive garnet, hornblende crystals, pyrrhotite and other minerals. Mr. Pritchard tells me that Mr. A. W. Howitt, who examined a specimen for him, says the rock consists entirely of Diallage.

Mount Consultation, four miles south-west of Castlemaine, is an old volcanic neck. Very little scoriaceous material remains, and on the south side the dense basaltic rock rises almost precipitously from the silurian below. The basalt is almost black, very fine grained, rarely vesicular, and has in some places a platy structure. The divisional planes are marked by whitish bands, and have a "dip" of about 40° inwards towards the vent, as shown on an arc of about 90°. The aneroid reading gave the height as 300 feet above the Castlemaine station or about 1200 feet above sea level. What is apparently a still more denuded neck, occurs at the head of the southern arm of Diamond Gully. The surface of the rock has been denuded equally with the silurian and occupies an area of about twelve acres, the ground being cultivated. The rock is apparently similar to that of Mount Consultation, but contains numerous angular fragments of sandstone embedded in it. A quarry hole twenty-two feet deep occurs, and the owner says the rock grows denser with increase of depth. Lower down the hill a shaft was sunk to pierce the basalt; at twenty-two feet however work was suspended. The gully which heads to this outcrop received its name from the occurrence of zircons, pleonastes and other gems derived probably from the basalt itself. Gems are also recorded from the older drifts of Diamond Hill. In order to ascertain the relative age of the basalt, I tried to find whether any had been procured from the oldest drift on the hill-top, but without success.

At Guildford, at the junction of Campbell's Creek and the Loddon, we find the older drifts capped by a basalt flow which, originating near the head waters of the ancient stream, has followed its course as far as the junction of Muckleford Creek.

* Notes on Samples of Rock, &c. Special Rep. Min. Dep., 189?, p. 1.

This flow has been denuded, and the old river course is shown by a chain of isolated flat-topped hills, known as the Loddon outliers.

Mount Franklin, twenty miles south of Castlemaine, is a well preserved cone of very recent date. The notes on the quarter-sheet (15 S.E.) state amongst other facts, that "The basaltic lava-streams of the country surrounding Mount Franklin and Franklinford are of two different ages. . . . . The more recent streams have poured into the present valleys, and in their gradual descent from the highest points of eruption have covered the post-pliocene as well as the older and newer pliocene drift. Only where they have acted as natural bars to, or lie in the line of drainage from higher levels, they are, in their turn covered by recent alluvium. The termination of the Jim Crow Creek flow is characterised by a very rugged surface and rocky escarpments, resembling the recent lava flows from the craters in the Western District." Thus we have then to the north of the Divide a very recent volcano, a fact which tends to weaken the generalisation of Professor David* that the most recent volcanoes occur near the sea coast, and the older further inland:—"The zone of volcanic activity in that country (*i.e.* Victoria) appears to have followed the southern shore-line which was constantly retreating southwards." To my mind Mount Franklin is quite as young as any of the volcanoes of the Western District which I have seen, the crater being beautifully perfect.

A dyke of grey quartz-felsite occurs in the Beehive Mine, Maldon, and several dykes are marked on the quarter-sheet. They are probably connected with the main granite mass.

In conclusion, I have to thank several of my friends in Castlemaine, including many of the mining managers of the surrounding district, for information, especially in regard to the past history of the goldfield—which has been of great service to me. My thanks are also due to Mr. A. W. Howitt, Secretary for Mines, for copies of the geological maps of the district, which have been of great use in the final preparation of my paper.

* Proc. A.A.A.S., 1892, p. 73.

List of some of the Minerals occurring in the Castlemaine District.

Most of these have been recorded by Mr. G. H. F. Ulrich in "Exhibition Essays," 1866, and in "Contributions to the Mineralogy of Victoria," 1870. A few new localities are recorded.

U = G. H. F. Ulrich.
H = T. S. Hall.

Albin (var. of Apophyllite). In druse, Harcourt granite quarry (H.) Identified by Mr. O. Rule.

Albite.—Quartz reef, Blacksmith's Gully (U.) Quartz reef at Francis Ormond, Garfield and reefs to north, Coomb's Gully, Crown Nimrod and several other quartz reefs (H.)

Alunogen as thick efflorescence, Barker's Creek slate quarries (H.)

Amphibole (black variety). Large imperfect crystals in basaltic dyke at Eureka Reef. Granite of Mount Alexander (U). In basic dykes, Wattle Gully, Burns' Reef, &c. (H.) (Green variety): Eaglehawk Reef, Maldon; found by Mr. G. B. Pritchard, and identified by Mr. A. W. Howitt.

Amethyst.—Common in Bradford Lead: some approach rose quartz in character (U.)

Augite.—Cavities in Malmsbury dolerite (U.)

Azurite.—Nicholson's Reef, Castlemaine (U.)

Barite.—Swiper's Reef, Maldon, in saddle-shaped crystals (U.) Crystals described and figured Ex. Ess., 1866. Cymru Mine, Maldon (J. Hornsby). Rare in platy crystals in quartz, Devonshire Mine, Castlemaine (H.)

Biotite.—Basaltic dyke, Eureka Reef, Castlemaine, also Campbell's Creek (U.) Dyke, Harcourt; dyke, Burns' Reef. Mount Alexander, granite (H.)

Bismuth (native) in small grains in quartz reef. Sandy Creek (U.)

Bismuthite, drift of Sandy Creek (U).

Calcite various recorded localities. Tarrengower (Maldon), Newstead (U.), Rhombohedra, quarter inch diam., Ajax Mine, Wattle Gully Mines. Masses up to a cubic foot, Ajax. *Travertine.* Limestone Creek. Crystals lining hollow dolomitic masses, Guildford, &c. (H.)

Cassiterrite, rare in Belltopper lead, Taradale (U.)

Cerussite.—Nicholson's Reef (U.)

Chabazite in basalt, Malmsbury (U.) Beehive Reef, Maldon (J. Hornsby).

Chalcopyrite in grains quartz reefs, Castlemaine and Maldon, as a vein several inches thick, Eaglehawk Reef, Maldon (U.) Harcourt granite, in small patches (H.)

Chalybite.—Eaglehawk Reef, Maldon, as lodestone of vein of copper-pyrites. Lisle's Reef (U.) See *Dolomite.*

Chlorite.—Rare as scaly coatings, Lady Gully and Wattle Flat, Blacksmith's Gully in quartz. In slate, Yandoit (U.) Coating imperfect quartz crystals and by decomposition, giving them a roughened appearance. Quartz Reef, Upper Loddon. Identified by Professor A. Liversidge (H.)

Chromic iron impregnated in quartz and quartzose rocks, Strathloddon (U.)

Chrome ochre.—Found at Strathloddon by Mr. (Colonel) Couchman (U.)

Copiapite (?)—As brownish crusts and stains on spoil and pyrites heaps (H.)

Copper (native).—Sparingly with gold, Specimen Gully Reef (U.)

Copperas.—In crystals, Beehive Reef (U.)

Covelline.—Specimen Gully (U.) Coating chalcopyrite, Harcourt and Scotchman's Gully (H.)

Damourite.—Bradford lead enclosed in smoky quartz (U.)

Dolomite.—Crystals, Lisle's Reef (U.) Varieties of calcite containing various quantities of iron and magnesia occur in various rhombohedra in Ajax and Wattle Gully Reefs, &c. Lenticular masses, strings and veins occur in the slates at Specimen Gully, Forest Creek. A white, soft, earthy substance consisting of carbonates of lime and magnesia occurs at the Barker's Creek quarries. A magnesian-lime cement occurs in some of the old gravels (H.)

Epidote (Epidote-rock).—Dyke, two and a half miles S.E. of Tarilta (U.)

Epsomite.—Eaglehawk Reef (U.) Argus Hill Co., as thick incrustation in old drives (H.)

Galena.—In nearly all auriferous reefs (U.) In fairly large grains, Scotchman's Gully (H).

Garnet (common red).—Drift of Barker's Creek, crystals embedded in smoky quartz, Bradford Lead (U.) In diallage dyke, Eaglehawk Reef (J. Hornsby); in granite, Maldon (J. Dennant); in granite, Harcourt quarries; granitic dyke, Expedition Pass (H.)

Gold.

Graphite.—An impure graphite coats slates in vicinity of quartz reefs, *e.g.*, Ajax, Englishman's, and many other reefs (H.)

Gypsum.—Clays, Mount Consultation, Sandy Creek (U.)

Gumbelite (?)—Replacing graptolites (H.)

Heulandite.—Sparingly, as drusy coatings, Lisle's, Lennox, and Tiverton Reefs (U.)

Hyalite.—Common in dolerite, Malmsbury (U.)

Ironglance.—In tabular crystals in quartz reefs, Sandy Creek; in tabular crystals in dolerite, Malmsbury (U.)

Labradorite.—Dolerite, Malmsbury, Loddon outliers.

Limonite.—As nodular concretions and veins in silurian rocks at Fryers, Maldon, Castlemaine, as cement of older drifts (U.) Pseudomorph after cubical pyrites; Wattle Gully, Bolivia Reef, forming iridescent films on rocks, common (H.)

Magnesite concretions in various localities (U.); concretions in Kampf's Gully (H.), Maldon (J. Hornsby).

Magnetite and *Ilmenite*, as black sand in alluvial deposits draining from basaltic country (H.)

Malachite.—Nicholson's Reef (U.); small earthy patches Scotchman's Gully Reef (H.)

Maldonite.—Nuggety Reef (U.) An alloy of bismuth and gold is obtained in some mines in Maldon at times, on "retorting" the mercury.

Mispichel.—Various recorded localities, massive, and in crystals (U.)

Molybdenite.—Granite, Maldon (U.) Quartz reefs, Maldon (J. Hornsby).

Mountain leather.—Tarilta (U.) Associated with tabular crystals of calcite in quartz reef, 900 feet level, South German Mine (H.)

Muscovite.—Granite generally (U.)

Nontronite.—Maldon (U.)

Oligoclase.—Scoria, Mount Franklin; greenish, in granite, Tarrengower, Harcourt (U.)

Olivene.—Newer basalt generally. Mount Franklin ash (U.) Basaltic dykes.

Orthoclase.—Granite generally; granite boundary, Elphinstone, Maldon, Harcourt. Large crystals, Bradford (U.) Large crystals, Mount Barker and Expedition Pass (H.)

Pharmacosiderite.—In cubical crystals, Beehive and German Reefs (U.)

Pholerite.—Blacksmith's Gully (U.); Ajax and Garfield Reefs, &c. (H.)

Pyrite.—Common in cited localities (U.) Cubes, Wattle Gully, in sandstone, &c. Octahedra, South Wattle Gully Mine. Pentagonal dodecahedra, Devonshire Mine (H.)

Pyromorphite.—Nicholson's Reef (U.)

Pyrrholite.—Specimen Gully, and several Maldon Reefs (U.) In diallage dyke, Eaglehawk Reef, Maldon (H.)

Quartz.—Common as reefs, hooded quartz, Pigeon Hill (figured) crystals large, Blacksmith's Gully, &c. (U.) *Smoky quartz:* Bradford, Tarrengower (U.) Harcourt Quarries (H.) *Prase:* Lady Gully (U.), Blacksmith's Gully, Ajax Reef, &c. (H.) *Lydianite:* Veins, Joyce's Creek (U.)

Sapphire.—Common in drift, Vaughan (U.)

Scorodite.—Crystals, Beehive Reef (U.)

Selenite.—Mount Consultation (U.)

Sphalerite (Zincblende).—Nuggetty Reef (U.) With gold, Francis Ormond, and Crown Nimrod Reefs, Scotchman's Gully, Mopoke Gully (H).

Steatite, as a vein, Strathloddon (U.)

Stibnite (Antimony glance), Fentiman's and Eaglehawk Reef (U).

Stilbite, in druse, in granite, Harcourt (H.) Identified by Mr. O. Rule.

Sulphur (native) with grey antimony, Fentiman's Reef (U.)

Topaz.—Gold drifts of Castlemaine district, Bradford lead (U.)

Tourmaline. Granite, of Mount Alexander, at Maldon (U.); Expedition Pass (H.)

Wad (black ferromanganese ore), quartz reefs common, as cement of conglomerates, Strangways, Tarilta (U.)

Wolfram.—Sandy Creek (U.)

Zircon.—Gold drift, Tarilta, Guildford, Hardhills, Campbell's Creek (U.)

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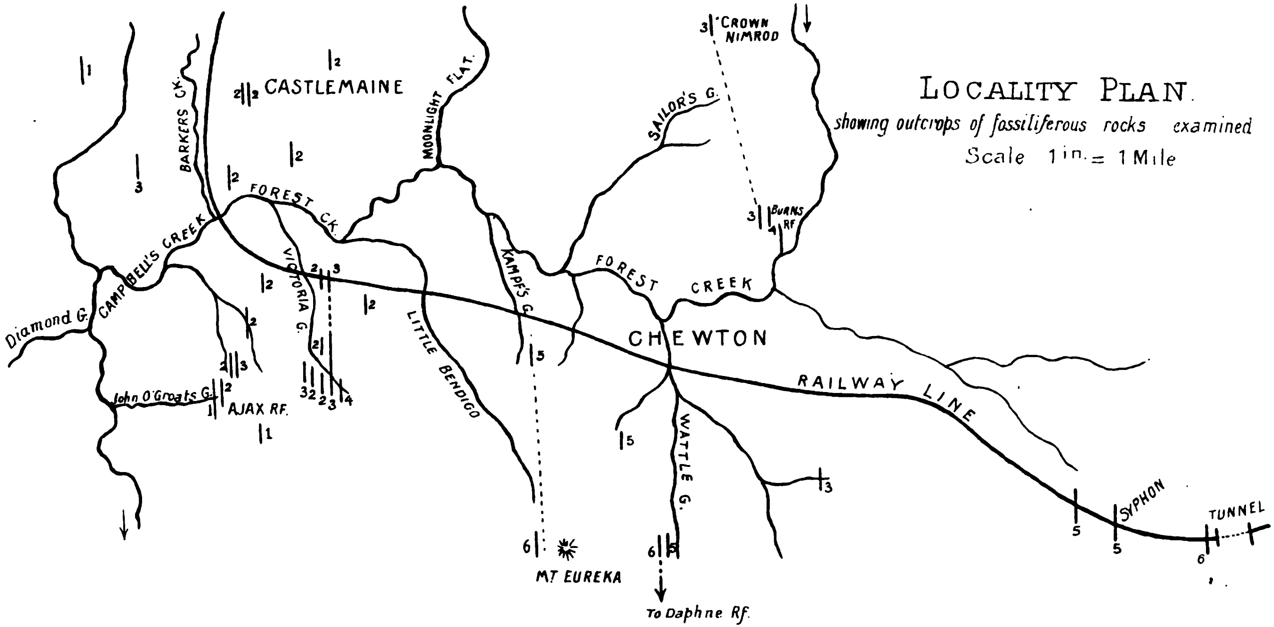
EXPLANATION OF PLAN.

1.—Outcrops of *L. Logani* zone.
2. ,, ,, *D. caduceus* zone.
3. ,, ,, *Phyllograpto-caduceus* zone.
4. ,, ,, Burns' Reef beds.
5. ,, ,, Wattle Gully beds.
6. ,, ,, *T. fruticosus* zone.


LOCALITY PLAN.
showing outcrops of fossiliferous rocks examined
Scale 1 in. = 1 Mile
CASTLEMAINE
CHEWTON
BARKERS CK.
FOREST CK.
FOREST CREEK
CAMPBELL'S CREEK
Diamond G.
John O'Groats G.
AJAX RF.
VICTORIA G.
LITTLE BENDIGO
MOONLIGHT FLAT.
KAMPF'S G.
SAILOR'S G.
CROWN NIMROD
BURNS RF
WATTLE G.
MT EUREKA
To Daphne Rf.
RAILWAY LINE
SYPHON
TUNNEL

ART. VII.—*The Sugar Strength and Acidity of Victorian Musts, with Reference to the Alcoholic Strength of Victorian Wines.*

PART II.

By W. PERCY WILKINSON.

[Communicated by R. L. J. Ellery, Esq., C.M.G., F.R.S., F.R A.S., 10th May, 1894.]

The present, being the second part of an enquiry into the sugar strength and acidity of Victorian musts, is the third part of a general investigation of Victorian wines—the first part of which related solely to the alcoholic strength of Victorian and other Australian wines. In the first part it was shown from the determination of the alcoholic strength of some 600 Australian Wines (*Journal of the Board of Viticulture for Victoria*, May 1892, pp. 81-96), that the average strength of Australian wines is 12 grammes of absolute alcohol per 100 cubic centimetres, as compared to an average of 8 grms. per 100 c.c. characteristic of French and German wines (nearly 2000 samples). In the second part, which was communicated to the Chemical Section of the Aust. Assoc. for Ad. Science, Adelaide, 1893, the investigation of the musts was taken up with a view to ascertaining in the first place whether the sugar strength of Victorian musts was great enough to account for the high alcoholic strength of Victorian (and all Australian) wines, and also to determine how the acidity of Victorian musts compared with those of France and Germany. In the present third part the results of the determinations of sugar strength and acidity of Victorian musts for the Vintage of 1894 are communicated, as it appeared desirable to control the determinations of the vintage of 1893 by a second and more extensive series in a different season and in more widely scattered districts. For the purposes of comparison and completeness the results of 1893 will be reproduced and discussed along with those of 1894.

It was found in the first part that the Victorian wines showed, on the average, an alcoholic strength half as large again as that

of the average French and German wines, for which elaborate data have been published by various French Chemists (Fauré, *Analyse chimique et comparée des Vins de la Gironde;* Gayon, Blarez, and Dubourg, *Analyse chimique des Vins de la Gironde,* 1888; Portes and Ruyssen, *Traité de la Vigne et de ses Produits,* 1886; *Documents du Laboratoire Muncipal;* and analyses by Houdart, Girard, and others given in Viard's *Traité Général de la Vigne et des Vins,* 1892), and the German Imperial Commission for Wine Statistics, appointed in 1884. *(Zeit. für Anal. Chemie.,* 27, *et seq).*

It was shown in the second part that the sugar strength of Victorian musts corresponds closely with the alcoholic strength of Victorian wines, in other words, that the average Victorian must contains nearly half as much sugar again as the average French and German. The determinations for 1894 bear out this interesting result, and show that, on the whole, the alcoholic strength of Victorian wines is fully accounted for by the high sugar strength of the musts. Some earlier investigations of the sugar strength of Australian musts had been made by the Hunter River Vineyard Association, commencing in 1847; Muspratt, 1857, and Dr. A. C. Kelly, 1867, also the South Australian Royal Commission in 1874, and by H. Lumsdaine, Chief Inspector of Distilleries, New South Wales, in 1875, and had proved the high specific gravity and therefore high sugar strength of Australian musts (for instance the South Australian Royal Commission found an average specific gravity of 1·118 for seventeen samples of grapes, representing 28·4 grammes of sugar per 100 cub. cent.) On account of the limited number of the earlier determinations, these two series of 1893 and 1894 were undertaken by me in order to have data as similar as possible to the systematic statistics being gathered for France and Germany, and especially the latter by the labours of the Imperial German Commission.

In the Victorian vintage of 1893 the number of samples of musts examined was 119, while in the present year it was 196, representing the chief wine-growing areas. Each sample was examined on the vineyard where produced, having been pressed by myself, the specific gravity and acidity of each being then taken immediately; the results of the measurements of specific

gravity and acidity are given for all the samples of 1893 and of 1894 in the tables at the end of this paper.

The specific gravities of the musts are referred to a temperature of 15° C., and water at 15° C.; having been determined by the Glucometre of Dr. Guyot. The specific gravity of a must is chiefly useful for giving an approximate value of its sugar strength, which can be derived most conveniently from the specific gravity by means of a table given by Salleron (*Notice sur les instruments de précision appliqués à l'Oenologie*, 1887), showing the relation between the density and sugar strength of a must, Salleron's allowance being made in that table for the effect of matters in the must other than sugar on the specific gravity. This allowance has been obtained as empirically suitable for French musts, and it remains to be ascertained how far it applies accurately to Australian musts, but for present purposes it must be accurate enough. Salleron's table is reproduced at the end of this paper; it should be noticed that in it the alcohol is expressed as the volume of alcohol in 100 volumes of the resulting spirit, whereas in the present paper the alcohol is always expressed as the weight in grammes in 100 cubic centimetres.

With regard to the measurement of acidity, a normal solution of Sodium hydrate (40 grammes of Na.H.O. per litre of solution) was used, with phenolphthalein as indicator for musts from white grapes, and for coloured musts the natural colouring matter of the must was used as indicator (as suggested by Pasteur).

Before comparing the average sugar strength and acidity of Victorian musts with those of the French and German, it will be as well to give separately the averages for 1893 and 1894, as follows :—

TABLE I.

Year.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free acids, calc. as Tartaric Acid. Grammes per 100 c.c.	Number of Samples.
1893	1·108	25·8	·72	119
1894	1·098	23·1	·79	196

With these we get the average of all the 315 samples given in the following table, along with the French and German averages:

TABLE II.

—	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free acids, calc. as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
France - -	1·083	19·1	·79	4·13
Germany - -	1·075	17·0	·96	5·65
Victoria - -	1·102	24·2	·76	3·14

It will be seen that although the sugar strength in Victorian musts for 1894 is somewhat lower than in those of 1893, the average strength of Victorian musts is about a third as great again as the French and German averages. The reasons for the slight variation in the Victorian averages for 1893 and 1894 are probably the difference in rainfall, that for 1893 being below, and that for 1894 being above the mean annual value; and the fact that, in order to overtake the greater number of samples of 1894, determinations had to be begun earlier must be borne in mind, as it caused the introduction into the average of a number of samples taken at the earliest stage of the vintage. But under all the conditions it may be said that the two years, 1893 and 1894, taken together have been favourable for giving results which must be close to those that would be obtained by averaging for a number of years.

The most interesting point in connection with the sugar strength of the average Victorian must is the estimation of the amount of alcohol which it can yield in the corresponding wine. According to the chemistry of the alcoholic fermentation of sugar it is allowed that when a solution of sugar is completely fermented the sugar yields almost exactly the half of its own weight of alcohol (strictly 48·6 per cent., see Pasteur, *Ann. de Chimie et de Phys.*, 3rd ser., **58**, p. 330). Accordingly, the 24·2 grammes of sugar in 100 c.c. of average Victorian must would,

on complete fermentation, yield 12·1 grammes of alcohol in 100 c.c. of wine, or more accurately 11·7. Now the average alcoholic strength of Victorion wines, as determined by me in the first part of this investigation, was 12 grammes of alcohol per 100 c.c. of wine, a number practically identical with that just calculated from the sugar strength of the average must; so that the high alcoholic strength of Victorian wines finds its explanation in the high sugar strength of Victorian musts.

With regard to acidity, it is shown in the above table that the acidity of our average Victorian must comes very close to that of the French average, but as the sugar is greater, the proportion of acid to sugar is lower than in the French case; to bring out this difference the column headed parts of acid to 100 parts of sugar has been given above, and it shows that the average Victorian must cannot be said to be simply a more concentrated form of the French and German musts, for while it is more concentrated or stronger as regards sugar it is weaker in acid. As to the amount of acid considered desirable in French and German practice, it is stated by Viard (*Traité Général de la Vigne*, 1892, p. 177), that a must ought not to contain less acid than is equivalent to ·7 to ·9 gramme of tartaric acid per 100 c.c. of must; and Fresenius has given a value nearly ·8 gramme of tartaric acid as characteristic of the must in a good year in Germany; this acidity is almost identical with the Victorian average, but to keep in the same proportion to its high sugar strength the Victorian average ought to be nearly 1·1 gramme of acid per 100 c.c.

The most interesting practical question brought out by these numbers is: Given that it is desirable, how far it is possible to bring the average Victorian wine nearer to the French and German standard? It is obvious that the first condition to be complied with is to bring the average Victorian must nearer to those of France and Germany by a reduction of the sugar strength and an increase of the acidity. That this is possible is proved completely by several individual instances in the tables at the end of this paper; some of which, for convenience, are selected and given separately in the following small table:

TABLE III.

District Number.	District.	Variety.	Specific Gravity, 15°/15°C.	Sugar. Grammes per 100 c.c.	Free Acids, calc. as Tartaric Acid. Grammes per 100 c.c.	Ratio of Acid to 100 parts Sugar.
1	Tabilk -	Carbenet Sauvignon -	1·104	24·7	1·03	4·19
6	,, -	Baxter Sherry -	1·094	22·0	1·03	4·71
8	,, -	Verdeilho - -	1·112	26·8	1·11	4·16
14	,, -	Mataro - -	1·073	16·4	1·59	9·73
2	Barnawartha -	Malbeck - -	1·088	20·4	1·08	5·30
7	,, -	Malbeck - -	1·099	23·4	1·01	4·31
9	,, -	Carbenet Sauvignon -	1·100	23·6	1·01	4·28
13	,, -	Mataro - -	1·084	19·4	1·08	5·56
14	,, -	Malbeck - -	1·096	22·6	1·01	4·46
15	,, -	Carbenet Sauvignon -	1·093	21·8	1·01	4·63
24	,, -	Riesling - -	1·095	22·3	1·01	4·52
6	Great Western	Mataro - -	1·078	17·8	1·14	6·41
10	,, -	Riesling - -	1·095	22.3	1·00	4·48
11	,, -	Tokay - -	1·087	20·2	1·07	5·30
12	,, -	Gouais - -	1·089	20·7	1·21	5·86
7	Yering -	Carbenet Sauvignon -	1·090	21·0	1·00	4·76
10	,, -	Riesling - -	1·090	21·0	1·14	5·44
11	Dookie -	Riesling - -	1·097	22·8	1·01	4·43
13	,, -	Baxter Sherry -	1·081	18·6	·86	4·65
5	Yackandandah	Riesling - -	1·082	18·8	·86	4·61
21	,, -	White Hermitage -	1·084	19·4	·86	4·47

Some of these are practically identical with the average of French and German musts, and others while stronger in sugar are also stronger in acid, so that the proportion of the two is the same as in the French and German. The question of securing a reduction in sugar strength and an increase in acidity in Victorian musts is connected with another of even greater importance to the Victorian wine growers, namely that of maintaining an approximately constant standard from year to year. In many of the vineyards no accurate scientific methods are used for determining the date of the vintage, the vigneron relying entirely on his own impression as to the fitness of the grapes for gathering; where the experience and judgment are great it is possible that the general impressions of the vigneron may be sufficient to guarantee a practically constant standard of must, but in the general case it would be a great assistance to the vigneron to have measurements taken from day to day of the sugar and acid in the grapes at the approach of the vintage, so that he could start gathering when the quantities were identical with those of some year in which he had obtained his best results. In this way he could secure, at least, the initial conditions for reproducing a wine like his best; of course much depends on the subsequent treatment of the must, but it is impossible that the same treatment, however careful, can give the same results from different musts. The measurements to be made are really simple, many vignerons at present determining the sugar for themselves, and a few both sugar and acids; it is only necessary that the practice of the latter should become more common to produce a greater uniformity in the main ingredients of the wines.

Although there is no doubt that recent researches have proved the powerful influence of the yeast (levure) in determining the character and quality of a wine, and also the importance of the temperature of fermentation, it still remains a fact that the fundamental properties of the wine depend upon the yeasts (levures) having the right material to work on, and it follows that the reasonable course for the vigneron to adopt is to get his must uniform as regards the two main constituents—sugar and acid—as he can easily do. It is evident that different standards will be necessary for different varieties of grapes, but the essential point is that of keeping

scientifically to the standard that has been found best. The same principles that apply to keeping a must uniform from year to year also apply to experiments in varying musts towards the French and German standards, and, as has been already remarked, many vignerons have prepared musts practically identical with those in sugar and acid. It is now assumed amongst the scientific authorities on wine-making that one function of the acids is to contribute to the formation of those ethers (esters) which constitute the bouquet.

Hitherto only the average must of the whole of Victoria has been under discussion, but interest also attaches to a comparison of the variations of the average must in different parts of the country. In the following table are given the averages for the different districts from the individual determinations in Table V. at the end of this paper.

Table IV.

VICTORIAN VINTAGE 1893.

MEAN DISTRICT RESULTS.

District.	Specific Gravity. 15°/15° C.	Sugar. Grammes per 100 c.c.	Free acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
Echuca	1·110	26·3	·72	2·72
Tabilk	1·100	23·6	·75	3·18
Barnawartha	1·111	26·6	·66	2·46
Yackandandah	1·115	27·6	·67	2·42
Beechworth	1·104	24·7	·80	3·24

VINTAGE 1894.

Echuca	1·101	23·9	·64	2·70
Tabilk	1·096	22·6	·86	3·83
Barnawatha	1·097	22·8	·82	3·61
Wahgunyah	1·102	24·2	·74	3·07
Dookie	1·100	23·6	·75	3·20
Yackandandah	1·105	25·0	·71	2·86
Great Western	1·091	21·2	·90	4·27
Yering	1·093	21·8	·87	4·01

Taking the results for 1894 as covering a larger area, we see that while the actual variation in sugar strength from one district to another is not great, yet the variation in the proportion of acids to sugar is considerable, but even in the sugar strengths there are variations of some importance; these might appear to be due to climatic influence, but I incline to think that differences in practice in the different districts would account largely for such variations as exist; this table shows again what was shown more fully in Table III., that it is possible to exercise a powerful control over the composition of musts.

The collection of the data of this paper for 1894 would have been impossible but for the assistance and hospitality extended to me by the owners and managers of the different vineyards, to whom I beg to offer my heartiest thanks, as also to the Premier, the Hon. J. B. Patterson, for practical encouragement in the work.

In the following Tables, V., VI., pp. 98 to 115, it must be remembered that the Sugar in grammes per 100 cubic centimetres is derived from the specific gravity according to Table VII., pp. 116 and 117, due to Salleron.

Table V.

VICTORIAN MUSTS.—VINTAGE 1894.

NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15°C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Tongala -	Hermitage - -	Feb. 24	1·131	31·9	·72	2·26
2	„ -	Hermitage - -	„ „	1·104	24·7	·72	2·91
3	„ -	Hermitage - -	„ „	1·101	23·9	·72	3·01
4	„ -	Glory of Australia -	„ „	1·095	22·3	·79	3·55
5	„ -	Dongelhino - -	„ „	1·102	24.2	·57	2·38
6	„ -	Black Hambro' -	„ „	1·099	23·4	·43	1·84
7	„ -	Carbenet Sauvignon	„ „	1·100	23·6	·57	2·44
8	„ -	Trebbiano - -	„ „	1·092	21·5	·64	3·01
9	„ -	Verdeilho - -	„ „	1·110	26·3	·79	3·01
10	„ -	Pedro Ximenes -	„ „	1·101	23·9	·72	3·01
11	„ -	Gouais - -	Feb. 26	1·100	23·6	·79	3·36
12	„ -	Terret (Oeillade) -	„ „	1·109	26·0	·43	1·66
13	„ -	Riesling - -	„ „	1·094	22·0	·72	3·30
14	„ -	Grenache - -	„ „	1·103	24·4	·57	2·30
15	„ -	Malbeck - -	„ „	1·099	23·4	·57	2·46

NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT—*(Continued)*.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
16	Tongala	Mataro	Feb. 26	1·101	23·9	·57	2·41
17	,,	Burgundy	Feb. 28	1·112	26·8	·50	1·88
18	Daracombe	Mataro	,, 27	1·104	24·7	·50	2·04
19	,,	Hermitage	,, ,,	1·120	29·0	·57	1·98
20	Eureka	Doradillo	,, ,,	1·087	20·2	·50	2·50
21	,,	Hermitage	,, ,,	1·102	24·2	·64	2·65
22	,,	Terret (Oeillade)	,, ,,	1·087	20·2	·50	2·50
23	,,	Riesling	,, ,,	1·086	19·9	·79	3·98
24	Newcombe	Hermitage	Feb. 28	1·106	25·2	·72	2·86
25	,,	Mataro	,, ,,	1·084	19·4	·79	4·08
26	,,	Riesling	,, ,,	1·094	22·0	·86	3·93
27	St. Helena	Pedro Ximenes	,, ,,	1·106	25·2	·64	2·57
28	,,	Terret (Oeillade)	,, ,,	1·114	27·4	·57	2·10
29	,,	Mataro	,, ,,	1·107	25·5	·50	1·98
30	,,	Hermitage	,, ,,	1·107	25·5	·72	2·82
31	,,	Riesling	,, ,,	1·099	23·4	·79	3·38
			Mean	1·101	23·9	·64	2·70
			Max.	1·131	31·9	·79	4·08
			Min.	1·084	19·4	·43	1·66

SOUTHERN GOULBURN VALLEY.—TABILK DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15°C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Château Tabilk -	Carbenet Sauvignon	March 27	1·104	24·7	1·03	4·19
2	,, -	Chasselas - -	,, ,,	1·095	22·3	·47	2·14
3	,, -	Mataro - -	,, ,,	1·094	22·0	·71	3·26
4	,, -	Hermitage - -	,, ,,	1·108	25·8	·79	3·09
5	,, -	White Hermitage -	,, ,,	1·103	24·4	·87	3·59
6	,, -	Baxter Sherry -	,, ,,	1·094	22·0	1·03	4·71
7	,, -	Riesling - -	,, ,,	1·091	21·2	·71	3·38
8	Goulburn Valley	Verdeilho - -	,, ,,	1·112	26·8	1·11	4·16
9	,, -	Carbenet Sauvignon	,, ,,	1·093	21·8	·87	4·02
10	,, -	Pineau blanc -	,, ,,	1·091	21·2	·79	3·76
11	,, -	Chasselas - -	,, ,,	1·107	25·5	·55	2·18
12	,, -	Riesling - -	,, ,,	1·090	21·0	·95	4·56
13	,, -	Doradillo - -	,, ,,	1·090	21·0	·55	2·66
14	,, -	Mataro - -	,, ,,	1·073	16·4	1·59	9·73
			Mean -	1·096	22·6	·86	3·83
			Max. -	1·112	26·8	1·59	9·73
			Min. -	1·073	16·4	·47	2·14

WAHGUNYAH DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	All Saints -	Hermitage - -	March 26	1·098	23·1	·79	3·45
2	" -	Gouais - -	" "	1·090	21·0	·71	3·42
3	" -	Pedro Ximenes -	" "	1·110	26·3	·79	3·03
4	" -	Aucarot - -	" "	1·100	23·6	·55	2·36
5	" -	Verdeilho - -	" "	1·115	27·6	·79	2·89
6	" -	Malbeck - -	" "	1·106	25·2	·71	2·84
7	" -	Riesling - -	" "	1·097	22·8	·71	3·14
8	" -	Grenache - -	" "	1·093	21·8	·79	3·66
9	" -	Tokay - -	" "	1·113	27·1	·71	2·64
10	" -	Chasselas - -	" "	1·095	22·3	·55	2·50
11	" -	Carbenet Sauvignon	" "	1·100	23·6	·79	3·38
12	" -	Brown Muscat -	" "	1·112	26·8	·95	3·57
			Mean -	1·102	24·2	·74	3·07
			Max. -	1·115	27·6	·95	3·66
			Min. -	1·090	21·0	·55	2·50

BARNAWARTHA DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Bordeaux	Brown Muscat	March 9	1·093	21·8	·79	3·64
2	,,	Malbeck	,, ,,	1·088	20·4	1·08	5·30
3	Barnawartha	Brown Muscat	,, ,,	1·106	25·2	·79	3·14
4	,,	Grenache	,, ,,	1·100	23·6	·86	3·66
5	,,	Riesling	,, ,,	1·095	22·3	·93	4·20
6	,,	Verdeilho	,, ,,	1·114	27·4	·93	3·42
7	,,	Malbeck	,, ,,	1·099	23·4	1·01	4·31
8	,,	Hermitage	,, ,,	1·091	21·2	·86	4·08
9	,,	Carbenet Sauvignon	,, ,,	1·100	23·6	1·01	4·28
10	,,	Aucarot	,, ,,	1·112	26·8	·86	3·22
11	Burrabunnia	Hermitage	March 10	1·087	20·2	·93	4·63
12	,,	Brown Muscat	,, ,,	1·096	22·6	·64	2·87
13	,,	Mataro	,, ,,	1·084	19·4	1·08	5·56
14	,,	Malbeck	,, ,,	1·096	22·6	1·01	4·46
15	,,	Carbenet Sauvignon	,, ,,	1·093	21·8	1·01	4·63
16	Rocky Point	Brown Muscat	March 11	1·082	18·8	·79	4·21
17	,,	Chasselas	,, ,,	1·095	22·3	·50	2·26
18	,,	Malbeck	,, ,,	1·101	23·9	·86	3·61
19	,,	Riesling	,, ,,	1·096	22·6	·93	4·14

BARNAWARTHA DISTRICT—*(Continued)*.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
20	Rocky Point -	Pineau blanc -	March 11	1·107	25·5	·64	2.54
21	,, -	Gouais - -	,, ,,	1·083	19·1	·93	4·90
22	,, -	White Hermitage -	,, ,,	1·083	19·1	·93	4·90
23	,, -	Hermitage - -	,, ,,	1·101	23·9	·79	3·31
24	Koendidda -	Riesling - -	,, ,,	1·095	22·3	1·01	4·52
25	,, -	Malbeck - -	,, ,,	1·106	25·2	·86	3·43
26	,, -	Hermitage - -	,, ,,	1·106	25·2	·72	2·86
27	,, -	Brown Muscat -	,, ,,	1·103	24·4	·86	3·54
28	Fassifern -	Malaga - -	,, ,,	1·088	20·4	·57	2·82
29	,, -	Gordo Blanco -	,, ,,	1·121	29·2	·43	1·47
30	Somerset -	Chasselas - -	,, ,,	1·085	19·6	·57	2·93
31	,, -	Malbeck - -	,, ,,	1·107	25·5	·72	2·82
32	,, -	Hermitage - -	,, ,,	1·105	25·0	·64	2·59
33	,, -	Riesling - -	,, ,,	1·100	23·6	·72	3·05
			Mean -	1·097	22·8	·82	3·61
			Max. -	1·121	29·2	1·08	5·56
			Min. -	1·082	18·8	·43	1·47

YACKANDANDAH DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Melville -	Aucarot - -	April 7	1·115	27·6	·71	2·57
2	,, -	Brown Muscat -	,, ,,	1·122	29·5	·71	2·40
3	,, -	Burgundy - -	,, ,,	1·124	30·0	·78	2·93
4	,, -	Verdeilho - -	,, ,,	1·124	30·0	·71	2·36
5	Riddington -	Riesling - -	,, ,,	1·082	18·8	·86	4·61
6	,, -	Brown Muscat -	,, ,,	1·105	25·0	·78	3·15
7	,, -	Madeira - -	April 8	1·084	19·4	·55	2·85
8	,, -	Pineau gris - -	,, ,,	1·107	25·5	·55	2·16
9	,, -	Burgundy - -	,, ,,	1·102	24·2	·78	3·26
10	,, -	Hermitage - -	,, ,,	1·099	23·4	·55	2 36
11	Staghorn -	Brown Muscat -	,, ,,	1·108	25·8	·63	2.44
12	,, -	Hermitage - -	,, ,,	1·108	25·8	·71	2·75
13	,, -	Verdeilho - -	,, ,,	1·115	27·6	·86	3·14
14	Westmoreland -	Burgundy - -	,, ,,	1·111	26·6	·71	2·67
15	,, -	Verdeilho - -	,, ,,	1·123	29·8	·63	2·11
16	,, -	Hermitage - -	,, ,,	1·101	23·9	·71	2·97
17	,, -	Brown Muscat -	,, ,,	1·114	27·4	·63	2·30
18	,, -	Riesling - -	,, ,,	1·101	23·9	·63	2·64
19	Ivyton -	Hermitage - -	,, ,,	1·119	28·7	·71	2·47
20	,, -	Reisling - -	,, ,,	1·088	20·4	·86	4.26
21	Balmoral -	White Hermitage -	,, ,,	1·084	19·4	·86	4·47
22	,, -	Mataro - -	,, ,,	1·090	21·0	·71	3·40
23	,, -	Malbeck - -	,, ,,	1·104	24·7	·86	3·51
24	,, -	Hermitage - -	,, ,,	1·101	23·9	·63	2·64
			Mean -	1·105	25·0	·71	2·86
			Max. -	1·124	30·0	·86	4·61
			Min. -	1·082	18·8	·55	2·11

GREAT WESTERN DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Great Western -	Hermitage - -	March 17	1·097	22·8	·92	4·07
2	,, -	Carbenet Sauvignon	,, ,,	1,095	22·3	·71	3·20
3	,, -	Malbeck - -	,, ,,	1·092	21·5	·85	4·00
4	,, -	Pineau noir - -	,, ,,	1·099	23·4	1·00	4 27
5	,, -	Burgundy - -	,, ,,	1·087	20·2	·85	4·24
6	,, -	Mataro - -	,, ,,	1·078	17·8	1·14	6·41
7	,, -	Espart - -	,, ,,	1·084	19·4	1·00	5·15
8	,, -	Red Frontignac -	,, ,,	1·096	22·6	1·00	4·42
9	,, -	Pineau blanc -	,, ,,	1·095	22·3	·71	3·20
10	,, -	Riesling - -	,, ,,	1·095	22·3	1·00	4·48
11	,, -	Tokay - -	,, ,,	1·087	20·2	1·07	5·30
12	,, -	Gouais - -	,, ,,	1·089	20·7	1·21	5·86
13	,, -	Sweetwater - -	,, ,,	1·083	19·1	·71	3·73
14	,, -	Chasselas - -	,, ,,	1·081	18·6	·64	3·45
15	,, -	White Frontignac -	,, ,,	1·087	20·2	1·21	6·00
16	,, -	Black Prince -	,, ,,	1·089	20·7	·78	3·79
17	,, -	Pedro Ximenes -	,, ,,	1·090	21·0	·92	4·42
18	,, -	Muscat of Alexandria	,, ,,	1·079	18·0	·78	4·35
19	St. Ethels -	Mataro - -	March 18	1·102	24·2	·85	3·45
20	,, -	Grenache - -	,, ,,	1·102	24·2	·92	3·83
21	,, -	Burgundy - -	,, ,,	1·101	23·9	·85	3·60
22	,, -	Malbeck - -	,, ,,	1·083	19·1	·92	4·85
23	,, -	Hermitage - -	,, ,,	1·102	24·2	1·00	4·13
24	,, -	Chasselas - -	,, ,,	1·099	23·4	·64	2·74
			Mean -	1·091	21·2	·90	4·27
			Max. -	1·102	24·2	1·21	6·41
			Min. -	1·078	17·8	·64	3·20

DOOKIE DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Fairburn Grange	Black Hambro' -	March 7	1·096	22·6	·86	3·82
2	„ -	Pedro Ximenes -	„ „	1·098	23·1	·93	4·05
3	„ -	Black Prince -	„ „	1·093	21·8	1·01	4·63
4	„ -	Chasselas - -	„ „	1·096	22·6	·50	2·23
5	„ -	Carbenet Sauvignon	„ „	1·105	25·0	·86	3·46
6	„ -	Baxter Sherry -	„ „	1·088	20·4	·79	3·88
7	„ -	Hermitage - -	„ „	1·099	23·4	·79	3·38
8	„ -	Gordo Blanco -	„ „	1·094	22·0	·79	3·60
9	„ -	Gouais - -	„ „	1·092	21·5	·79	3·68
10	„ -	Hermitage - -	„ „	1·105	25·0	·79	3·17
11	„ -	Riesling - -	„ „	1·097	22·8	1·01	4·43
12	„ -	Gordo Blanco -	March 13	1·089	20·7	·57	2·78
13	„ -	Baxter Sherry -	„ „	1·081	18·6	·86	4·65
14	„ -	Hermitage - -	„ „	1·112	26·8	·79	2·95
15	„ -	Riesling - -	„ „	1·104	24·7	·86	3·50
16	„ -	Black Hambro' -	„ „	1·091	21·2	·86	4·22
17	„ -	Carbenet Sauvignon	„ „	1·106	25·2	1·01	4·00
18	„ -	Gordo Blanco -	„ „	1·109	26·0	·64	2·49
19	„ -	Riesling - -	„ „	1·109	26·0	·79	3·05
20	„ -	Pedro Ximenes -	„ „	1·111	26·6	·79	3.00
21	„ -	Gouais - -	„ „	1 112	26·8	·64	2·41
22	„ -	Black Prince -	„ „	1·098	23·1	·86	3·74
23	Koimburra -	Malaga - -	March 14	1·102	24·2	·36	1·48
24	„ -	Gordo Blanco -	„ „	1·099	23·4	·57	2·46
25	„ -	Black Hambro' -	„ „	1·075	17·0	·64	3·81

DOOKIE DISTRICT—*(Continued)*.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
26	Koimburra	Black Prince	March 14	1·086	19·9	·79	4·00
27	,,	Black St. Peter	,, ,,	1·090	21·0	·79	3·77
28	,,	Baxter Sherry	,, ,,	1·086	19.9	·79	4·00
29	Dookie College	Gordo Blanco	,, ,,	1·096	22·6	·57	2·54
30	,,	Carbenet Sauvignon	,, ,,	1·116	27·9	·79	2·84
31	,,	Hermitage	,, ,,	1·130	31·6	·64	2·05
32	Château Dookie	Shepherd's Riesling	,, ,,	1·110	26·3	·64	2·47
33	,,	Mataro	,, ,,	1·106	25·2	·86	3·43
34	,,	Gouais	,, ,,	1·097	22·8	·86	3·78
35	,,	Pedro Ximenes	,, ,,	1·109	26·0	·64	2·49
36	,,	Hermitage	,, ,,	1·117	28·2	·72	2·55
37	,,	Chasselas	,, ,,	1·103	24·4	·50	2·07
38	,,	Tokay	,, ,,	1·101	23·9	·64	2·71
39	,,	White Hermitage	,, ,,	1·096	22·6	·79	3·51
40	Stoneleigh	Carbenet Sauvignon	,, ,,	1·108	25·8	·79	3·07
41	,,	White Hermitage	,, ,,	1·110	26·3	·57	2·20
42	,,	Malbeck	,, ,,	1·103	24·4	·72	2·95
43	,,	Riesling	,, ,,	1·100	23·6	·79	3·36
			Mean	1·100	23·6	·75	3·20
			Max.	1·130	31·6	1·01	4·63
			Min.	1·075	17·0	·36	1·48

YERING DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15°C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Yering -	Hermitage - -	March 22	1·090	21 0	·85	4·08
2	„ -	Merlot - -	„ „	1·092	21·5	1·28	5·95
3	„ -	White Hermitage -	„ „	1·101	23·9	·78	3·28
4	„ -	Mataro - -	„ „	1·085	19·6	·92	4·73
5	„ -	Pineau blanc -	„ „	1·095	22·3	·78	3·52
6	„ -	Pineau gris - -	„ „	1·104	24·7	·71	2·87
7	„ -	Carbenet Sauvignon	„ „	1·090	21·0	1·00	4·76
8	„ -	Malbeck - -	„ „	1·095	22·3	·85	3·84
9	„ -	Gouais - -	„ „	1·077	17·5	1·07	6·12
10	„ -	Riesling - -	„ „	1·090	21·0	1·14	5·44
11	St. Huberts -	Hermitage - -	„ „	1·101	23·9	·78	3·28
12	„ -	Carbenet Sauvignon	„ „	1·092	21·5	·78	3·65
13	„ -	Chasselas - -	„ „	1·088	20·4	·57	2·80
14	„ -	White Hermitage -	„ „	1·098	23·1	·64	2·78
15	„ -	Riesling - -	„ „	1·100	23·6	·92	3·93
			Mean -	1·093	21·8	·87	4·01
			Max. -	1·104	24·7	1·28	5·95
			Min. -	1·077	17·5	·57	2·78

TABLE VI.

VINTAGE 1893.

NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Tongala	Muscat Red	March 9	1·124	30·0	·34	1·13
2	,,	Muscat Red	,, 12	1·160	39·0	·70	1·80
3	,,	Burgundy	,, 9	1·125	30·3	·76	2·50
4	,,	Burgundy	,, 10	1·113	27·1	·75	2·77
5	,,	Burgundy	,, 11	1·144	35·4	1·12	3·16
6	,,	Burgundy	,, 11	1·140	34·3	·76	2·22
7	,,	Pedro Ximenes	,, 10	1·093	21·8	·82	3·76
8	,,	Verdeilho	,, 10	1·108	25·8	·86	3·33
9	,,	Terret Oeillade	,, 10	1·096	22·6	·76	3 36
10	,,	Riesling	,, 11	1·092	21·5	·82	3·81
11	,,	Riesling	,, 14	1·096	22·6	·76	3·36
12	,,	Riesling	,, 17	1·101	23·9	·75	3·14
13	,,	Carbenet Sauvignon	,, 12	1·117	28·2	·75	2·66
14	,,	Hermitage	,, 12	1·124	30·0	·82	2·73
15	,,	Dongelhino	,, 12	1·116	27·9	·86	3·08
16	,,	Black St. Peter	,, 12	1·088	20·4	·60	2 94
17	,,	Unknown	,, 12	1·116	27·9	·75	2·68
18	,,	Malbeck	,, 13	1·112	26·8	·75	2·77
19	,,	Carignane	,, ,,	1·094	22·0	·62	2·82
20	,,	Unknown	,, ,,	1·133	32·4	·80	2·47
21	,,	Chasselas	,, ,,	1·107	25·5	·45	1·76

NORTHERN GOULBURN VALLEY.—ECHUCA DISTRICT—*(Continued).*

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
22	Tongala -	Terret & Hermitage -	March 13	1·114	27·4	·62	2·26
23	,, -	Black Prince -	,, ,,	1·096	22·6	·75	3·32
24	,, -	Grenache - -	March 15	1·120	29·0	·76	2·62
25	,, -	Doradillo - -	,, ,,	1·094	22·0	·41	1·87
26	,, -	Sultana - -	,, ,,	1·120	29·0	·62	2·14
27	,, -	Sweet-water - -	,, ,,	1·100	23·6	·75	3·17
28	,, -	Trebbiano - -	,, ,,	1·114	27·4	·65	2·37
29	,, -	Mataro & Hermitage	March 16	1·117	28·2	·62	2·20
30	Daracombe -	Mataro - -	,, 10	1·096	22·6	1·12	4·95
31	Killarney -	Mataro - -	,, 11	1·106	25·2	·62	2·46
32	,, -	Hermitage - -	,, 11	1·107	25·5	·76	3·00
33	Newcombe -	Hermitage - -	,, 15	1·123	29·8	·76	2·55
34	,, -	Riesling - -	,, 17	1·100	23·6	·65	2·80
35	St. Helena -	Hermitage - -	,, 15	1·116	27·9	·65	2·30
36	,, -	Morellion - -	,, 17	1·080	18·3	·75	4·10
37	,, -	Terret - -	,, ,,	1·116	27·9	·55	2·00
38	,, -	Black Prince -	,, ,,	1·090	21·0	·62	3·00
39	,, -	Mataro - -	,, ,,	1·130	31·6	·62	1·96
40	,, -	Black St. Peter -	,, ,,	1·084	19·4	·76	3·91
41	Eureka -	Terret - -	March 18	1·100	23·6	·75	3·18
			Mean -	1·110	26·3	·72	2·72
			Max. -	1·160	39·0	1·12	4·95
			Min. -	1·080	18·3	·34	1·13

SOUTHERN GOULBURN VALLEY.—TABILK DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Château Tabilk -	White Hermitage -	April 8	1·109	26·0	·75	2·90
2	„ -	Riesling - -	„ „	1·095	22·3	·90	4·03
3	„ -	Gouais - -	„ „	1·091	21·2	·82	3·86
4	„ -	Hermitage - -	„ „	1·100	23·6	·92	3·90
5	„ -	Black Prince -	„ „	1·081	18·6	·62	3·33
6	„ -	Pedro Ximenes -	„ „	1·074	16·7	·45	2·70
7	Goulburn Valley -	Doradillo - -	„ „	1·065	14·3	·48	3·35
8	„ -	Chasselas - -	„ „	1·100	23·6	·52	2·20
9	„ -	Verdeilho - -	„ „	1·116	27·9	·85	3·05
10	„ -	Hermitage - -	„ „	1·116	27·9	·82	2·93
11	„ -	Mataro - -	„ „	1·103	24·4	·85	3·48
12	„ -	Black Hambro' -	„ „	1·130	31·6	·92	2·90
13	„ -	Muscat - -	„ „	1·150	37·0	·95	2·57
14	Cameron's -	Burgundy - -	April 9	1·107	25·5	·92	3·60
15	„ -	Muscatel, white -	„ „	1·095	22·3	·75	3·36
16	„ -	Muscatel, brown -	„ „	1·088	20·4	·85	4·16
17	„ -	Mataro - -	„ „	1·099	23·4	·65	2·77
18	„ -	Hermitage - -	„ „	1·122	29·5	·75	2·54
19	„ -	Black Hambro' -	„ „	1·101	23·9	·88	3·68
20	„ -	Black Prince -	„ „	1·092	21·5	·68	3·16
21	„ -	Riesling - -	„ „	1·101	23·9	·75	3·14
22	„ -	Chasselas - -	„ „	1·092	21·5	·55	2·56
23	„ -	Pedro Ximenes -	„ „	1·091	21·2	·55	2·60
24	„ -	Baxter Sherry -	„ „	1·094	22·0	·82	3·73
			Mean -	1·100	23·6	·75	3·18
			Max. -	1·150	37·0	·95	4·16
			Min. -	1·074	16·7	·45	2·20

BARNAWARTHA DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15°C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Bordeaux -	Malbeck - -	March 27	1·104	24·7	·75	3·03
2	,, -	Hermitage - -	,, ,,	1·109	26·0	·92	3·54
3	Fairview -	Muscat - -	,, ,,	1·158	38·6	·72	1·86
4	,, -	Malbeck - -	,, ,,	1·117	28·2	·58	2·05
5	Mundadda -	Riesling - -	March 28	1·112	26·8	·50	1·86
6	,, -	Gouais - -	,, ,,	1·100	23·6	·58	2·45
7	,, -	White Hermitage -	,, ,,	1·112	26·8	·56	2·10
8	,, -	Baxter Sherry -	,, ,,	1·086	19·9	·53	2·66
9	,, -	Chasselas - -	,, ,,	1·104	24·7	·53	2·14
10	,, -	Hermitage - -	,, ,,	1·123	29.8	·73	2·45
11	,, -	Malbeck - -	,, ,,	1·106	25·2	·67	2·65
12	,, -	Mataro - -	,, ,,	1·103	24·4	·67	2·74
13	Wakefield -	Malbeck - -	,, ,,	1·112	26·8	·73	2·72
14	,, -	Hermitage - -	,, ,,	1·126	30·6	·80	2·61
15	Somerset -	Malbeck - -	,, ,,	1·116	27·9	·70	2·51
16	,, -	Riesling - -	,, ,,	1·101	23·9	·61	2 55
17	,, -	Chasselas - -	,, ,,	1·092	21·5	·53	2·46
18	Barnawartha -	Sweet water - -	March 29	1·100	23 6	·45	1·90
19	,, -	Gouais - -	,, ,,	1·091	21·2	·61	2·88
20	,, -	Chasselas - -	,, ,,	1·083	19·1	·41	2·14

BARNAWARTHA DISTRICT—*(Continued)*.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15°C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
21	Barnawartha -	Malbeck - -	March 29	1·121	29·2	·70	2·40
22	,, -	Muscat - -	,, ,,	1·150	37·0	·83	2·24
23	,, -	Isabella - -	,, ,,	1·102	24·2	·58	2·40
24	,, -	White Hermitage -	,, ,,	1·102	24·2	·70	2·90
25	,, -	Aucarot - -	,, ,,	1·130	31·6	·70	2·21
26	,, -	Verdeilho - -	,, ,,	1·123	29·8	·75	2·51
27	,, -	Hermitage - -	,, ,,	1·132	32·2	·77	2·40
28	,, -	Riesling - -	,, ,,	1·111	2·66	·70	2·63
29	,, -	Grenache - -	,, ,,	1·100	23·6	·70	2·96
30	,, -	Mataro - -	,, ,,	1·101	23·9	·66	2·76
			Mean -	1·111	26·6	·65	2·46
			Max. -	1·158	38·6	·92	3·54
			Min. -	1·083	19·1	·41	1·86

YACKANDANDAH DISTRICT.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	Hadley Bros. -	Riesling - -	March 30	1·092	21·5	·84	3·92
2	,, -	Hermitage - -	,, ,,	1·102	24·2	·71	2·93
3	Staghorn -	Burgundy - -	,, ,,	1·132	32·2	·80	2·48
4	,, -	Muscat - -	,, ,,	1·136	33·2	·61	1·83
5	,, -	Verdeilho - -	,, ,,	1·125	30·3	·71	2·34
6	,, -	Tokay - -	,, ,,	1·109	26·0	·60	2·31
7	,, -	Riesling - -	,, ,,	1·096	22·6	·70	3·10
8	,, -	Hermitage - -	,, ,,	1·114	27·4	·71	2·60
9	Melville -	Burgundy - -	,, ,,	1·136	33·2	·70	2·17
10	,, -	Madeira - -	,, ,,	1·087	20·2	·51	2·52
11	,, -	Riesling - -	,, ,,	1·101	23·9	·65	2·71
12	,, -	Verdeilho - -	,, ,,	1·126	30·6	·70	2·28
13	,, -	Hermitage - -	,, ,,	1·114	27·4	·65	2·37
14	,, -	Aucarot - -	,, ,,	1·121	29·2	·71	2·43
15	,, -	Muscat - -	,, ,,	1·130	31·6	·71	2·25
16	Westmoreland -	Riesling - -	,, ,,	1·105	25·0	·60	2·40
17	,, -	Muscat - -	,, ,,	1·123	29·8	·60	2·01
18	,, -	Burgundy - -	,, ,,	1·124	30·0	·65	2·17
19	,, -	Verdeilho - -	,, ,,	1·126	30·6	·65	2·12
20	,, -	Hermitage - -	,, ,,	1·107	25·5	·60	2·34
			Mean -	1·115	27·6	·67	2·42
			Max. -	1·136	33·2	·84	3·92
			Min. -	1·087	20·2	·51	1·83

BEECHWORTH.

Progressive Number.	Name of Vineyard.	Variety of Grape.	Date of Examination.	Specific Gravity, 15°/15° C.	Sugar. Grammes per 100 c.c.	Free Acids, calculated as Tartaric Acid. Grammes per 100 c.c.	Parts of Acid to 100 parts Sugar.
1	O'Connor's -	Hermitage (6 yrs. old)	March 30	1·101	23·9	·73	3·05
2	,, -	Hermitage (26 yrs. old)	,, ,,	1·100	23·6	·70	2·96
3	,, -	Verdeilho (6 yrs. old)	,, ,,	1·108	25·8	·92	3·56
4	,, -	Verdeilho (26 yrs. old)	,, ,,	1·107	25·5	·88	3·45
			Mean -	1·104	24·7	·80	3·24

TABLE VII.

Showing the relation between density and degrees Baumé; with the Sugar corresponding in grammes per 100 cubic centimetres of Must, according to Salleron, *Notice sur les Instruments de précision appliqués à 'Oenologie,* 1887

Density 15°/15° C.	Degrees Baumé.	Grammes of Sugar per 100 c.c. of Must.	Alcohol in Volume.
1050	6·9	10·3	6·0
1051	7·0	10·6	6·2
1052	7·1	10·8	6·3
1053	7·2	11·1	6·5
1054	7·4	11·4	6·7
1055	7·5	11·6	6·8
1056	7·6	11·9	7·0
1057	7·8	12·2	7·2
1058	7·9	12·4	7·3
1059	8·0	12·7	7·5
1060	8·1	13·0	7.6
1061	8·3	13·2	7·8
1062	8·4	13·5	7·9
1063	8·5	13·8	8·1
1064	8·6	14·0	8·2
1065	8.8	14·3	8·4
1066	8·9	14·6	8·6
1067	9·0	14·8	8·7
1068	9·2	15·1	8·9
1069	9·3	15·4	9·0
1070	9·4	15 6	9·2
1071	9·5	15·9	9·3
1072	9·7	16·2	9·5
1073	9·8	16·4	9·6
1074	9·9	16·7	9·8
1075	10·0	17·0	10 0
1076	10·2	17·2	10·1
1077	10·3	17·5	10·3
1078	10·4	17·8	10·5
1079	10·5	18·0	10·6
1080	10·7	18·3	10·8
1081	10·8	18·6	10·9
1082	10·9	18·8	11·0
1083	11·0	19·1	11·2
1084	11·1	19·4	11·4
1085	11·3	19·6	11·5
1086	11·4	19·9	11·7
1087	11·5	20·2	11·9
1088	11·6	20·4	12·0
1089	11·7	20·7	12·2
1090	11·9	21·0	12·3
1091	12·0	21·2	12·5
1092	12·1	21·5	12·6
1093	12·3	21·8	12·8
1094	12·4	22·0	12·9
1095	12·5	22·3	13·1
1096	12·6	22·6	13·3
1097	12·7	22·8	13·4
1098	12·9	23·1	13·6

TABLE VII. *(Continued).*

Density 15°/15° C.	Degrees Baumé.	Grammes of Sugar per 100 c.c. of Must.	Alcohol in Volume.
1099	13·0	23·4	13·8
1100	13·1	23·6	13·9
1101	13·2	23·9	14·0
1102	13·3	24·2	14·2
1103	13·5	24·4	14·3
1104	13·6	24·7	14·4
1105	13·7	25·0	14·5
1106	13·8	25·2	14·6
1107	13·9	25·5	14·7
1108	14·0	25·8	14·8
1109	14·2	26·0	15·0
1110	14·3	26·3	15·1
1111	14·4	26·6	15·2
1112	14·5	26·8	15·3
1113	14·6	27·1	15·4
1114	14·7	27·4	15·5
1115	14·8	27·6	15·6
1116	15·0	27·9	15·7
1117	15·1	28·2	15·9
1118	15·2	28·4	
1119	15·3	28·7	
1120	15·4	29·0	
1121	15·5	29·2	
1122	15·6	29·5	
1123	15·7	29·8	
1124	15·9	30·0	
1125	16·0	30·3	
1126	16·1	30·6	
1127	16·2	30·8	
1128	16·3	31.1	
1129	16·5	31·4	
1130	16·6	31·6	
1131	16·7	31·9	
1132	16·8	32·2	
1133	16·9	32·4	
1134	17·0	42·7	
1135	17·2	33·0	
1136	17·3	33·2	
1137	17·4	33·5	
1138	17·5	33·8	
1139	17·6	34·0	
1140	17·7	34·3	
1141	17·8	34·6	
1142	17·9	34·8	
1143	18·0	35·1	
1144	18·1	35·4	
1145	18·2	35 6	
1146	18·4	35·9	
1147	18·5	36·2	
1148	18·6	36·4	
1149	18·7	36·7	
1150	18·8	37·0	

TABLE VIII.

DISTRICT MEAN ANNUAL TEMPERATURE AND RAINFALL.

On the authority of R. L. J. Ellery, Esq., C.M.G., F.R.S., Government Astronomer.

	March, 1892, to March, 1893.	Rainfall for Twelve Months.	Mean Annual Rainfall.	Mean Annual Temperature.
	Name of Stations.	Inches.	Inches.	Degrees.
Barnawartha District	Retreat Vineyard -	24·39	28·02	59·3
	Hermitage, The -	20·19	22·76	
	Beechworth - -	31·88	32·40	56·9
	Echuca - - -	17·66	18·23	59·6
	Lilydale - -	35·07	36·99	57·7
	Nagambie - -	23·30	28·80	58·4
	Rutherglen - -	22·00	24·64	60·0
Yering District	Yering Town - -	28·94	33·97	57·8
	St. Hubert's Vineyard-	31·61	30·53	
	Yackandandah - -	37·92	45·36	59·1

	March, 1893, to March, 1894.	Rainfall for Twelve Months.	Mean Annual Rainfall.		Mean Annual Temperature.
	Name of Stations.	Inches.	Inches.	No. of Years.	Degrees.
Barnawartha District	Retreat Vineyard	33·90	27·47	8	59.3
	Hermitage, The	28·87	22·78	8	
	Beechworth -	46·83	32·17	22	56·1
	Echuca - -	19·18	18·16	15	60·3
	Lilydale - -	35·21	36·25	8	57·7
	Nagambie -	26·87	26·72	7	58·4
	Rutherglen -	28·55	24·70	10	60·0
Yering District	Yering Town -		33·55	10	57·8
	St. Hubert's Vin.		31·14	3	
	Yackandandah -	48·80	42·26	7	59·1
	Dookie - -	27·86	22·36	14	60·6
	Wahgunyah -	26·73	22·04	21	60·3
	Great Western -		23·73	2	68·7

ART. VIII.—*Geological Notes on the Country between Strahan and Lake St. Clair, Tasmania.*

(With Map.)

By GRAHAM OFFICER, B.Sc., LEWIS BALFOUR, B.A., and E. G. HOGG, M.A.

[Read 14th June, 1894.]

The following sketch is the outcome of observations collected during a trip made by the authors in January of this year from Strahan to Lake St. Clair along the overland track.

The first thing of interest, that does not seem to have been recorded as yet, is the occurrence about a mile from Strahan along the track of a deposit which bears a striking similarity to the glacial drift in Victoria. It consists of an unstratified or faintly stratified clay, of great hardness in places, and through which stones and boulders are irregularly scattered. One of these boulders was two feet in diameter, and several bore striæ. In places the clay has a peculiar pinkish-purple colour that is very characteristic of the glacial beds near Bacchus Marsh. As a similar deposit occurs on Mount Tyndall and also on Mount Sedgwick, not very far distant, it is not improbable that the two are identical. We did not observe a direct junction with the Silurian rocks which appear here and occur all the way to the great central plateau.

Mounts Lyell and Owen form part of the West Coast Range, and are at a distance of some thirty miles from Strahan by the track. These two mountains run approximately parallel to each other in an E. and W. direction, being separated by the wide, open Linda Valley. At their westerly extremity they are connected by a narrow saddle, which rises to a height of about 1500 feet above sea level; from this end arises the Linda Creek, which, after being joined by its tributaries, runs due east down the valley for about four miles, when it flows into the King River. Towards its lower end the valley narrows rapidly as the eastern spurs of Mounts Owen and Lyell approach each other.

The Linda Valley has attracted much attention owing to the gold found in its alluvial, and to the other valuable minerals occurring in the ridge bounding it on the west. As might have been expected, in the case of a valley lying between two high mountains composed mainly of the older formations in a highly disturbed region, the geological problems to which it gives rise are very complex.

The lowest rocks exposed consist of schists (principally hydromica), sandstones, quartzites, and conglomerates. These are all inclined at high angles, and have been assigned to Lower Silurian age. Capping and apparently forming the greater mass of Mounts Owen and Lyell is a great series of sandstones and conglomerates. The Linda Valley is to a great extent filled by more recent deposits. The so-called Silurian rocks occur at the upper end of the valley, and may be recognised again at the lower end on the Linda Creek. The ridge joining Mounts Owen and Lyell at the west extremity of the valley is almost, if not entirely, composed of schist. Owing to accumulations of *débris* and the occurrence of thick scrub, and consequent difficulty of observation, it is very hard to determine with anything like precision the geological relationships of the rocks in this country. While certain Lower Silurian fossils have been obtained from rocks in the vicinity, yet, until a careful survey is made, it will be very difficult indeed to assign any given outcrop to a certain age. There are at least two sets of the older rocks with an unconformity between, and it seems quite possible that there may be a third. Thus we should not be surprised if the schists forming the ridge at the head of the Linda Valley turned out to be Cambrian or even Archæan.

Pyrites occurs abundantly through these ancient rocks, and micaceous and specular iron is plentiful; veins of the latter can be seen traversing pink conglomerate, in which the included pebbles are apparently all of quartz and quartzite.

One of the principal features of the western end of the Linda Valley is the now celebrated "Iron-Blow," a mass of hæmatite, and the closely-associated lode (so-called) of pyrites, which is now being worked by the Mount Lyell Company. This mass is apparently interbedded with the country rock, and is inclined at about 63°. The hanging wall is schist, and the footwall conglomerate.

The lode which the Mount Lyell Company are working consists essentially of pyrites. According to Dr. Peters, whose report on the mine was published last year, the great bulk of the ore mass consists of iron and copper pyrites, with a little heavy spar (barium sulphate), and silica, and traces of antimony, arsenic, lead and zinc. This ore also contains about 3 oz. of silver and 2½ dwt. of gold to the ton. Besides this main body of ore, pockets of argentiferous copper pyrites and silver-copper glance occur. This class of ore has proved enormously rich, yielding several thousand ounces of silver to the ton, besides a large percentage of copper.

Several theories have been put forth to account for the formation of the ore, but the most satisfactory is that proposed by Dr. Peters and Mr. Montgomery. According to these gentlemen, the mass of pyrites is an ore-bed contemporaneous with the enclosing country rock, having been probably deposited in a swamp or lagoon of the period. The ore-bed has a thickness of 300 ft. at the surface, this thickness representing, on the above theory, the original depth of the deposit, which may therefore be pretty confidently expected to be of very large extent.

Resting unconformably on the older schistose rocks, with their accompanying sandstones and conglomerates, are massive beds of conglomerate interstratified with sandstones, which are very characteristic of the West Coast Range as a whole. These beds may be traced from the level of the Linda Valley to the summits of both Owen and Lyell. They have in general a south-westerly dip at an inclination of about 40° to 45°; but at the top of Mount Lyell, where they constitute the plateau on which the trigonometrical station was erected, they are dipping to the N.W. at an angle of 15°. They are much jointed, and show a tendency to foliated structure. The included stones, which are almost invariably quartz and quartzites, vary in size from small pebbles to boulders of at least two feet in diameter, thus giving the rock a very striking appearance. The beds are pierced by quartz-veins, which traverse both matrix and included pebble, and the jointing planes, in dividing the rock, also cut right through the quartz pebbles. The foliated structure, which causes the quartz to flake off in thin sections, would appear to show the intense compression to which the beds have been subjected. The matrix

of the conglomerate is a hard, silicious sandstone. The interstratified sandstones, which occur in beds of considerable thickness, vary greatly in character, some being fine, others coarse, and others highly micaceous. A bed of the micaceous sandstone, overlaid by a fine conglomerate, forms the summit of Mount Lyell. From the conglomerate and sandstones lying at the western end of Mount Lyell gold has been obtained in more or less payable quantities. The rocks have in general an appearance of great antiquity, and extending as they do over a large tract of country, their origin, geological age, and the position of the quartzitic highlands of which they are the *débris* are questions of great interest. So far as our examination of these beds went, they were unfossiliferous; but certain sandstone boulders containing fossils found on West Mount Lyell, and also on the button-grass plains lying east of the King River, may yet be traced to them. Mr. Moore is of opinion that they should be classified as Devonian. Mr. Montgomery, Government Geologist, in his recent paper on "Glacial Action in Tasmania," states that the Owen conglomerates are conformably interbedded with the quartzites and schists of this district. If he refers to the conglomerates forming the mass of Mount Owen, as we presume he does, our observations lead us to believe that this is erroneous, and that, as we have already stated, there are two sets of conglomerates here—one intercalated with the schists and sandstones, the other—the massive Owen conglomerates—lying unconformably over them.

Among the beds of later origin in the valley is a soft black clay, called by the miners "pug." It attains a considerable depth in places, and rests unconformably on all the older rocks. It is in places stratified, and is said to contain intercalated beds of lignite. It is reported that shells have been found in it, though we were unable to detect any. It contains numerous particles of free pyrites, and would appear, without doubt, to have been formed by the disintegration of the adjacent schistose rocks containing pyrites. Its distribution is confined to the western end of the valley. There is a good outcrop of it just beneath the Iron Blow, and it may be also found at Karlson's Face and at a considerable elevation on the saddle on the Copper Creek. It is probably of lacustrine origin.

Overlying the "pug" is a series of clay, sand, and gravel beds. Two typical sections may be seen on the track to the Queen River, within a short distance from the Iron Blow. The first of these consists of soft irregularly-stratified clay, with bands of grit and larger stones here and there. These rest upon schist, which is much broken and decomposed. It is covered by angular hill-wash. The second, a little further on, shows an unstratified clay containing numerous rounded, angular and sub-angular stones irregularly scattered through the matrix. The stones range from small pebbles up to boulders a foot in diameter. Irregular bands of stratified material, stained with iron, occur here and there. The included stones consist of quartz, quartzites, and hard sandstones, evidently obtained from the adjoining hills. Some of the stones are well striated. On the track between the boarding-house and the Iron Blow occur patches of a dark, tenacious clay, from which well-marked striated stones were procured.

Mr. T. B. Moore, in a recent paper recording the discovery of scored stones from this locality, states that the Linda Valley is covered with a layer of morainal matter. He is also of opinion that "the deep ground hydraulically sluiced" for gold in the upper part of the Linda Valley "is nothing but a huge mass of morainal matter."

Although striated stones undoubtedly occur in the Linda Valley, we must be careful not to ascribe too much to the action of ice, for it must be borne in mind that landslips and other gravitational results may produce, to a greater or less extent, many of the effects noticed in a glaciated area. Further research may bring to light other evidence of glacial action in the shape of *roches moutonnées*, erratics, &c.; and in the absence of such evidence we hestitate in coming to any definite conclusion as to the origin of the striations observed.

The head of the valley, which we should have expected to be somewhat bare and denuded of surface material, had it been occupied by a glacier, within Pleistocene times at least, is filled to a great extent by the pug, clays, gravels, &c., already referred to, besides a great accumulation of angular *débris*, which has gravitated from the adjoining heights. We are inclined to think that much of the morainal matter referred to by Mr. Moore is

simply this gravitated *débris.* Any appearance of *roches moutonnées* is quite absent; on the contrary, whenever any of the bed-rocks appear, they are invariably rough and rugged. The slopes of both Mounts Owen and Lyell are studded with great masses of conglomerate, which have moved down from above, and here and there huge columns of rock, often with smaller blocks perched on their summits, may be seen, and which have evidently weathered into their present state *in situ.*

Lake Beatrice lies some ten miles from the King River Crossing, between Mount Sedgwick and Eldon Peak. It is in the same line of drainage as Lakes Dora, Rolleston, and Spicer, which lie to the north. A stream flows out of the lower end of the lake, which, after a course of two or three miles, joins the King River. This stream is remarkable for the immense size of the boulders in its bed. Not only in the bed of the stream, but on either side, spread over the low-lying ground, do these boulders occur in great profusion. The accumulations show a decided tendency to form ridges. The boulders consist principally of a very hard grit or fine conglomerate, and many of them must be tons in weight. The country here is so densely covered by scrub (beech, sassafras, "horizontal," and bauera) that we found it almost impossible to get any observations of the bed-rock.

The ridge-like form of the boulder accumulations at once suggests a morainic origin. As Messrs. Dunn and Moore showed last year, well-marked evidences of glaciation occur about Lake Dora and the other lakes no great distance away; and Lake Beatrice, as already remarked, is in the same line of drainage; so it would not be surprising if these boulder accumulations really owe their origin to glacial causes. The action of water alone does not seem sufficient to account for their transport, although it is true immense floods must have poured down this valley when the upper parts were occupied by glaciers and almost perpetual snow during the Pleistocene period.

Mr. T. B. Moore states that the King River Valley is covered with morainic matter. Numerous boulders of white sandstone, up to two feet in diameter, many containing masses of brachiopod fossils, are scattered over the valley, being generally concealed by the peaty soil and thick button-grass. Some of this material

may have been originally morainic; but, in the absence of further evidence, it seems to us most probable that it has been distributed to its present position by the King River when flowing at a higher level. On the overland track a cutting occurs, about one-third of a mile from the crossing, which shows a "wash" of water-worn pebbles and boulders that is evidently of fluviatile origin, and which is about fifty or sixty feet above the present level of the stream.

If we are to believe that these boulders have been transported to their present position by the direct action of ice, we will have to admit a much wider glaciation in Tasmania than is generally believed to have taken place, the height of the King River Valley at this place being only 600 or 700 feet above the sea. We may add that other evidence of glaciation in the form of *roches moutonnées* and ground moraines seemed to be quite absent. We noted a large mass of greenstone lying close to the track about a mile from the crossing, and resting on Silurian, which is much decomposed and broken up on the surface. But it would be unwise to infer much from this one instance. There may be a dyke in the vicinity.

From the King River to the Victoria Pass the rocks are of an ordinary Silurian type—slates, shales, and sandstones. Fossils are abundant in places. At a cutting on the track near the King River crinoids were abundant, and trilobites and other forms were common, but we saw no graptolites. Our specimens have unfortunately gone astray.

From Victoria Pass the character of the rocks changes to white quartzites and quartz and talcose schists, while the hills are much barer of vegetation than those further west, a fact probably due to the nature of the rocks, which are, of course, nearly pure silica. At the Collingwood River micaceous sandstones occur, and then from the Franklin River, the white quartzites and schists extend to Mount Arrowsmith. Mount Arrowsmith is just at the edge of the great central plateau of Tasmania, which varies from 2000 to 4000 feet above the sea. Leaving Mount Arrowsmith, the Silurian rocks are also left behind, and one sees instead the massive greenstone crests of Mounts Gell, King William, Rufus, Hugel, and other more or less prominent heights.

At a lower level than the majestic greenstone columns at the summit of Mount King William I. are the almost horizontal beds of the Carboniferous sandstones. The characteristic fossils are very abundant (spirifers, fenestellidæ, &c.). Immediately below the columns, a section clearly shows that this sandstone has been subjected to a severe baking. The rock has been hardened and browned, and much resembles in consistency a well-made brick. In the short time at our disposal we were unable exhaustively to search for fossils; but, in a few instances, evidences of their former existence in the deposit was established by the presence of a few casts. Instead of showing clearly, as in the section a few hundred yards away, these remnants, too, bore signs of considerable baking, which seems to be additional evidence on the comparative ages of the greenstone and Carboniferous sandstones.

Some discussion has been going on, and differences of opinion have been expressed, on this point. Gould, Strzelecki, and Tenison-Woods considered that the greenstone was post-Carboniferous. Jukes suggested the possibility of its being pre-Carboniferous. Mr. R. M. Johnston maintained the latter view in his "Geology of Tasmania." Professor David, in his presidential address before the A.A.A.S. at Hobart, thought that the greenstone was decidedly of later age than the Carboniferous and Mesozoic rocks. Mr. Graham Officer, in a paper read before the Royal Society of Tasmania last year, produced evidence that the greenstone was post-Carboniferous. Mr. Montgomery's observations also confirm this view. It is only fair to say that Mr. Johnston has modified his views, and now considers, with most other observers, that the greenstone is post-Carboniferous, although he has not yet published this opinion.

The difficulty in deciding this question has always been to obtain the point of contact; a difficulty caused principally by the disintegration and subsequent falling of the greenstone columns, which generally obscure the line of junction. In this section, however, although the actual point of contact is not exposed, the sandstone is observed at a distance of only a few yards from the vertical greenstone columns, and as the former bears unmistakable evidence of having been subjected to a considerable amount of heat, the inference is that the greenstone

has been erupted through the sandstone. The later age of the former may now be considered an ascertained fact.

Lake George, which lies at the foot of Mount King William, has been put down as probably of glacial origin. If this be a fact, further evidence must be adduced to support it. We traversed the steep slopes leading down from the mountain without observing any evidences of former ice action. The horizontally bedded sandstone forms a series of terraces across the gorge leading down to the lake, a form one would hardly expect to see if the rocks had been recently ice-worn. However, there is a large bank or low hill across the lower end of the lake, the appearance of which in the distance certainly suggests a moraine. We were, however, unable to reach it, as the day was far spent.

About eight miles south-west of the southern extremity of Lake St. Clair lies Lake Dixon, a small lake a few acres in extent. The rocks in the immediate neighbourhood present points of considerable geological interest.

The lake is picturesquely situated in a valley about 2000 feet above sea-level, while the eminences within a few miles rise to a height of another 2000 feet.

The Franklin River, here near its source, having flowed through Lake Undine a few miles north, enters Lake Dixon at its northern extremity, emerging again at the southern end.

The neighbourhood of Lake Dixon forms the junction of the east and west drainage areas of Tasmania. The Franklin runs with a general south-westerly direction, afterwards joining the Gordon, which ultimately flows into Macquarie Harbour on the west coast ; while Lake George, at the foot of King William I., about seven or eight miles south of Lake Dixon, and also the Cuvier, a few miles north, drain into the Derwent.

Especially on the western and northern slopes of Lake Dixon are seen numerous outcrops of the Silurian, or possibly older, rocks. They are composed principally of quartzites, quartz-schists, and talcose schists, and are in many places exceedingly hard.

They are all highly inclined, with a general north and south strike. They present wavy, flowing outlines, the exposed smoothed and well-polished surfaces glittering in the sunlight. Individual striæ it is difficult to find, this being probably due to

the nature of the rock, but the general form and surface is typical of *roches moutonnées*—so typical, in fact, as to render a detailed description unnecessary.

In some places recent soil and grass have covered these polished surfaces, but enough is exposed to show that there exists a considerable area of *roches moutonnées.* In other spots, where the surface is quite bare, erratics of various sizes rest immediately on the polished rock.

Of morainic matter there is abundance. The surface of the country round the lower end of the lake, extending for about a mile from the lake, is strewn with rocks of all sizes and shapes and in all positions. Many are large, being some tons in weight, while others are small or of only moderate size. They are composed almost exclusively of greenstone, and it may be mentioned that it is at times difficult, if not impossible, to determine the line of demarcation between the moraines and the shattered columns of greenstone which have gravitated down the valley. Quartzites also occur in the moraine.

Mr. Johnston, in a paper read before the Royal Society of Tasmania last year, remarks that "the romantic . . . valley of Lake Dixon is, *par excellence*, the ideal of a perfect glacier valley. No one, however ignorant of glacial action, could in this neighbourhood gaze upon those beautiful, scooped, or rather abraded, lakes or tarns, . . . the snow-white, polished, billowy, cascade-like *roches moutonnées*, composed of quartzites, on the upper margin of Lake Dixon, together with the tumbled moraines and large erratic on the lower banks—at a level of about 2000 feet—without being impressed with the idea that its singularly characteristic features must have been produced by the slow rasping flow of an ancient river of ice."

In addition to the smoothed rocks, we discovered, clinging to to these surfaces, and principally in the hollows, part of the former ground moraine. This consisted of an intensely hard matrix of clay, in which were embedded and cemented together pebbles and stones of various kinds and sizes, composed of schists, slates, quartzites, greenstone, and other varieties. No attempt at arrangement is discernable, and one distinguishing feature is the occurrence on many of the included stones of scores and striæ. These striations are numerous and well-marked, which,

taken in conjunction with the character and position of the matrix, mark the deposit as a true till or ground moraine.

Lake Dixon, to all appearance, is very shallow. Its edges are not deep, though some of the slopes above are decidedly steep. Reeds grow in the lake for some distance from its northern extremity. It is quite probable that Lake Dixon is a morainic lake.

As to the age of this ice action, it is difficult to say more than that everything tends to show that it has been the work of recent glaciers. The finding of erratics still resting on the polished surfaces is suggestive, while the valley seems to have altered but little since the time when the river of ice slowly made its way downwards.

At first sight it seems strange that we have such direct evidence of glaciation in this valley of the Lakes Undine and Dixon, while the evidence in some of the surrounding valleys is negative. It is of importance, however, to remember that elevation is but one condition essential for the former glaciation in this region. Important elements to be considered are the contour, size, and length of the valley. This valley seems to be admirably adapted, not only for being a gathering-ground of snow, but also for the conversion of this snow into a glacier. Surrounded as it is by mountains rising to a height of 2000 feet above its level—itself 2000 feet above the sea—snow would inevitably collect to some considerable extent, while the slope of the valley would cause sufficient movement in the glacier to enable it to carve and polish and scoop the hard rocks. Added to this, the glacier would be supplemented by tributaries descending from the minor valleys to right and left. At present the snow in winter must be considerable. The last of the previous winter's snow had not melted on Olympus by the end of January, so it is not necessary to assume a very extensive fall of temperature to account for perpetual snow in these regions.

The geology of Lake St. Clair has already been described by Mr. Officer (Trans. Roy. Soc. Tas., 1893). The main features are similar to those about Mount King William, the mountains—*e.g.*, Olympus, Byron, Cuvier, Ida, etc.—consisting of a base of sandstone (Permo-Carboniferous), capped by greenstone. The possibility of its being a glacial lake is worth considering. There

is a great accumulation of greenstone *débris* at its southern end, but it is difficult to say if it is *in situ* or not. The ridge-like form much of this *débris* takes is at least suggestive of moraines.

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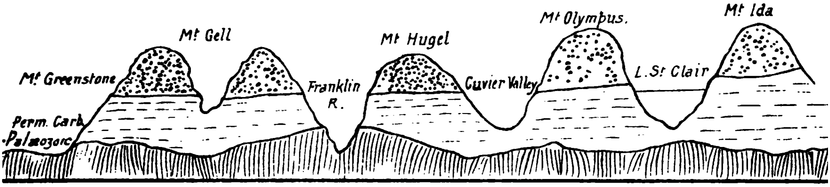
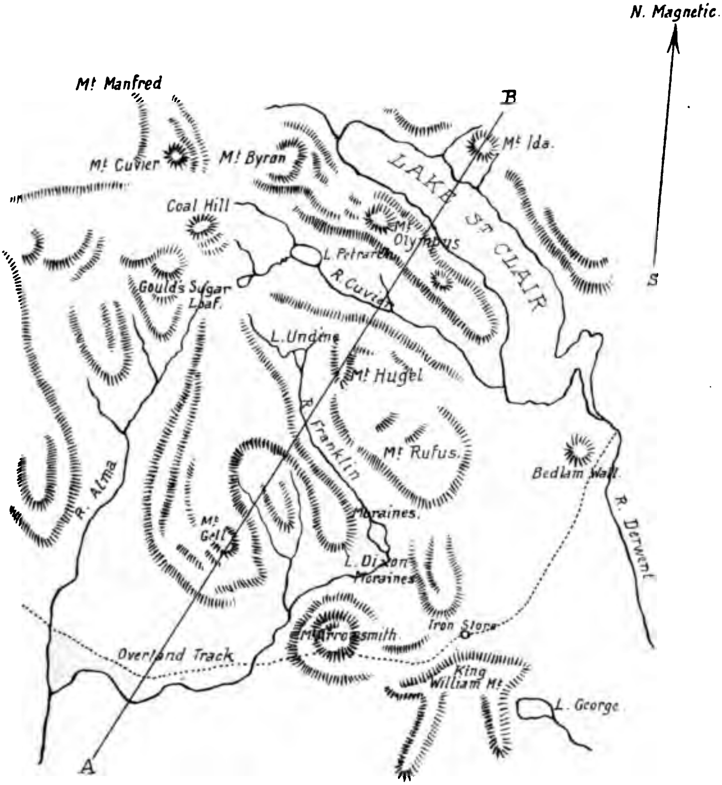


Diagrammatic Section along line A. B



Scale
5 Miles to 1 inch.

R. Wendel lith.

ART. IX.—*On the Australian Species of Amathia.*

By P. H. MACGILLIVRAY, M.A., LL.D., M.R.C.S., F.L.S.

[Read 12th July, 1894.]

Several species of Amathia have long been known to occur on the Australian coasts, and were described by Lamouroux and Lamarck. Of late years several others have been added to the list. A great deal of confusion, however, exists as to what these species really are. This has been partly owing to the imperfection of the descriptions, and in some cases to the want of figures.

In the present paper I give descriptions and figures of all those with which I am acquainted, by which I trust that Australian observers will have no difficulty in identifying the species. No doubt others will be discovered, especially from New South Wales, Queensland and Northern Australia, from which my materials are very scanty.

AMATHIA, Lamouroux.

(= SERIALARIA, Lamarck.)

Class, Polyzoa. Division Ectoprocta. Order Infundibulata. Sub-order Ctenostomata. Family Vesiculariidæ.

Generic character.—Zoarium radicate, with free, filiform, usually dichotomous branches, divided by more or less distinct joints or partitions. Zoœcia sub-tubular, occasionally in one, but mostly in two, parallel rows, in continuous series or in distinct groups, which are placed on one, or rarely on two, sides of the branches, or are wound spirally partially or wholly round them.

* Zoœcia forming a continuous or interrupted spiral.

1. A. SPIRALIS, Lamouroux.

(Plate A., Fig. 1.)

Amathia spiralis, Lamouroux, Hist. des Polypiers Coralligènes Flexibles, p. 161, pl. iv., fig. 2; Expos. Methodique des Genres

de Polypiers, p. 10, pl. 65, figs. 16, 17; MacGillivray in McCoy's Prodromus of Zoology of Victoria, pl. 185, fig. 2.

Serialaria convoluta, Lamarck, Anim. Sans Vertebres, ed. 1, ii., 131; ed. 2, ii., 170; ed. 3, i., 212.*

Serialaria spiralis, De Blainville, Manuel d'Actinologie, p. 476.

Zoarium forming dense tufts several inches high, attached by fine radical tubes. Branches erect, stiff, dichotomously divided. Zoœcia long, narrow, united laterally through their whole length to form a continuous uniserial spiral, interrupted only at the bifurcations and closely applied to the branch; each zoœcium convex, the contiguous walls of adjoining zoœcia united and projecting upwards as slight points.

Port Philip Heads. Port Jackson, Mr. Whitelegge.

Grows in large tufts, the largest I have seen being nearly five inches high. The branches are long, dichotomously divided, with a length of a quarter to half an inch between the bifurcations. The zoœcia are long, narrow, united side to side to form a continuous spiral closely united or adpressed to the branches which they conceal, and interrupted only at the bifurcations. They are convex, separated by grooves, the united contiguous margins projecting upwards as small points; when dried the anterior surface is collapsed and depressed, the separating walls projecting and their upward prolongations being more prominent.

2. A. bicornis, Tenison Woods.

(Plate A., Fig. 2.)

Serialaria spiralis, Tenison Woods, Proc. Roy. Soc., New South Wales, July, 1877.

Amathia bicornis, T. Woods, Proc. Roy. Soc., Victoria, June, 1879; MacGillivary in McCoy's Prod. Zool. Vict., pl. 185, fig. 1.

Zoarium forming dense tufts one or two inches high. Branches irregularly divided. Zoœcia rather long, slightly convex, closely united side to side and arranged in spiral clusters of about two complete turns, the cylindrical stem being unoccupied for nearly

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* My copy is ed. 3, Brussels, 1837. It is, I believe, the same as the 2nd edition, edited by Deshayes and Milne Edwards, the extensive additions and new observations on the Polypes being by the latter naturalist. The references to the other editions are taken from Miss Jelly's invaluable Catalogue of Marine Bryozoa.

the same length between the clusters; each zoœcium with a long hollow process on each side, about a half of its length and with a rounded sinus between them.

Port Phillip Heads. Marouba Bay, New South Wales, Mr. Whitelegge.

This is a very marked species, at once distinguished by the separate spiral clusters of zoœcia with the free stem between them, and by the peculiar long, thick, hollow processes from the orifices.

Dr. Pergens, writing without evidently having seen Mr. Woods' proposed name *A. bicornis* (Bull. Soc., Malacol, Belgique, 1887), considers that the name *A. spinosa* attached by Desmarest and Leseur to a figure of this species should be retained. As, however, neither description nor figure was ever published, Mr. Tenison Woods' name must stand.

3. A. CONVOLUTA, Lamouroux.

(Plate A., Fig. 3.)

Amathia convoluta, Lamouroux, Pol. Corall. Flex., p. 160; De Blainville, Man. d'Actinologie, p. 476.

Serialaria crispa, Lamarck, Anim. Sans Vertebres, ed. 1, ii., 131; ed. 2, ii., 172; ed. 3, i., 212.

Amathia spiralis, Busk, Challenger Polyzoa, pt. ii., p. 34, pl. vi., fig. 2.

? *A. tortuosa*, Busk, l.c. p. 34, pl. vi., fig. 1.

Zoarium forming tufts of rather loose, long, straggling, irregularly divided branches. Zoœcia long, narrow, arranged in a continuous spiral interrupted at the divisions of the branches, diverging from the axis above and leaving portions of the stem visible between the turns; each zoœcium convex, the contiguous margins not produced into a point.

Port Philip Heads, Mr. J. Bracebridge Wilson.

Forms loose tufts of an olive or brownish colour, the branches two or three inches high and irregularly divided. The zoœcia are long, narrow, closely united laterally except sometimes at the apertures, and forming an open spiral of about one or one and a half turns in each internode, the free margin diverging considerably from the stems, which are conspicuously visible in the

opening of the spiral. The orifices of the zooecia are not quite so closely united and the adjacent margins are not produced.

No figure was published by Lamouroux or Lamarck, but there can, I think, be no doubt that this is the species intended by them. Lamarck gives Schweiger as an authority for the name *A. convoluta*, but I have not seen his work. It is undoubtedly Busk's *A. spiralis*, and I can see no difference between that and his *A. tortuosa*.

4. A. TORTUOSA, Tenison Woods.

(Plate A., Fig. 4.)

Amathia tortuosa, Tenison Woods, Proc. Roy. Soc. Victoria, June, 1879; MacGillivray in McCoy's Prod. Zool. Vict., pl. 185, fig. 3.

Amathia connexa, Busk, Challenger Polyzoa pt., ii., p. 35, pl. vi., fig. 3.

Zoarium forming long, straggling, irregularly divided, rather slender, cylindrical, transparent branches, several inches high. Zoœcia rather long, in biserial clusters at nearly right angles to the stems and forming an open spiral of one complete turn, occupying greater part of each internode but leaving a small portion inferiorly free.

Port Philip Heads. Port Jackson (Dr. Ramsay).

There can be no doubt that this is the species described and figured by Mr. Woods, and that Busk's *A. tortuosa*, if not identical, as I believe, with *A. convoluta*, is at all events quite distinct from the present.

5. A. DISTANS, Busk.

(Plate C., Fig. 3.)

Amathia distans, Busk, Challenger Polyzoa, pt. ii., p. 38, pl. vii., fig. 1; MacGillivray, Trans. Roy. Soc. South Australia, June, 1889.

Zoarium forming long, slender, straggling, transparent branches. Zoœcia irregularly biserial, united into clusters forming very open spirals of about one complete turn occupying the upper half of each internode.

South Australia.

I have only a small specimen of this species. It is readily distinguished by the long, very slender, filamentous stems and the spiral cluster of zoœcia occupying the upper half of each internode, the lower part being bare. The zoœcia are rather short, and not very closely united.

** Zoœcia in straight or oblique clusters.

† No appendages.

6. A. LENDIGERA, Linnæus sp.

(Plate B., Fig. 1.)

Amathia lendigera, Lamouroux, Pol. Corall. Flex., p. 159; Id. Expos. Method, p. 10; Hincks, Brit. Mar. Pol., p. 516, pl. lxxiv., figs. 7-10; Busk, Challenger Pol., pt., ii., p. 33.

Serialaria lendigera, Lamarck, An. Sans Vertebres, ed. 1, ii., 130; ed. 2, ii., 169; ed. 3, i., 211; De Blainville, Man. d'Actinologie, p. 476; Johnston, Brit. Zoophytes, ed. 2, p. 368.

Zoarium consisting of dichotomously divided, slender, intricately interwoven branches. Zoœcia in straight, biserial clusters of 4-8 pairs, diminishing in height from the proximal to the distal, and occupying the upper third or half of an internode.

Western Port, Rev. Mr. Porter.

Of this the only Australian specimen I have agrees precisely with the well known European form. It is closely allied to the succeeding, under which the distinguishing characters are pointed out.

7. A. OBLIQUA, new species.

(Plate B, Fig. 2.)

Zoarium consisting of slender, dichotomously divided branches, not interwoven. Zoœcia in oblique, biserial clusters of 6-9 in each row, occupying almost the whole length of the straight internodes.

Port Philip Heads.

This is closely allied to *A. lendigera* with which it seems to have been considered identical by Mr. Kirkpatrick. The habit of growth, however, is quite different. It forms tufts of considerable

height, one measuring five inches. It is only attached by the bases of the main stems by radical tubes, the branches being quite free and not intertwining or climbing over other objects. The zoœcial clusters are markedly oblique and extend over nearly the whole length of the internodes, never being restricted to so small a portion as the half. The large size of the zoœcial clusters, and its more regular growth give it a much stouter appearance. In both species the zoœcia are more separated than in the others.

8. A. PINNATA, Kirkpatrick.

(Plate C., Fig. 1.)

Amathia pinnata, Kirkpatrick, Ann. and Mag. Nat. Hist., July, 1888.

Zoarium pinnately branched. Zoœcia arranged in biserial clusters of 12-16 pairs, occupying greater part of the front of each internode.

Port Philip Heads, Mr. J. Bracebridge Wilson.

The only specimen I have of this very distinct species is that figured. Being the extremity of a growing branch the secondary branches are not so fully formed as in older parts, one on a side being sometimes undeveloped or aborted.

9. A. BROGNIARTII, Kirkpatrick.

(Plate B., Fig. 3.)

Amathia Brogniartii, Kirkpatrick, Ann. and Mag. Nat. Hist., July, 1888.

Zoarium consisting of dichotomously divided branches. Internodes long, thick and straight, occupied for almost the whole length by a biserial cluster of long, nearly uniform, connate zoœcia.

Port Philip Heads, Mr. J. Bracebridge Wilson.

Distinguished by the great length and straightness of the internodes and the number of the zoœcia from *A. biseriata*, the only species with which it can be confounded. I give Kirkpatrick as the authority for the name, as Desmarest and Leseur, who seem to have indicated it and from whom Mr. Kirkpatrick took

the name, merely had figures prepared, and never published either plates or descriptions.

10. A. BISERIATA, Krauss.

(Plate B., Fig. 4.)

Amathia biseriata, Krauss, Corallineen und Zoophyten der Sudsee, 1837, p. 23, fig. 1. *A. inarmata*, MacGillivray, Proc. Roy. Soc. Vict., Nov., 1886; Prod. Zool. Vict., pl. 185, fig. 4.

Zoarium forming large tufts of dichotomously divided branches. Internodes of moderate length, slightly arcuate, almost entirely occupied on one side by a biserial cluster of 6-9 pairs of zoœcia, which usually slightly diminish in height from the proximal to the distal extremity.

Port Phillip Heads. Sealers Cove, Baron von Mueller. Westernport.

When I previously described this species as *A. inarmata* I had not seen Krauss' work, and could not procure a copy of it. After seeing his description and figure, I am satisfied that the Australian and South African species are identical. The amount of curvature of the internodes varies, some being almost straight. From *A. Brogniartii*, it differs in the arching and shortness of the internodes, and the small number of zoœcia, and from *A. Woodsii* in the absence of the confervoid filaments, the smaller number and greater thickness of the zoœcia and their not diminishing in size distally in the very marked manner they do in the latter species.

†† With filamentous or confervoid appendages.

11. A. CORNUTA, Lamouroux.

(Plate D., Fig. 1.)

Amathia cornuta, Lamouroux, Pol. Corall, Flex., 159; pl. iv., fig. 1.

Amathia Australis, Tenison Woods, Proc. Roy. Soc. N.S.W., July, 1877.

Serialaria cornuta, Lamarck, Anim. Sans. Vertebres, Ed. 1, ii., 131; ed. 2, 131; ed. 3, i., 212.

Zoarium consisting of dichotomously divided branches, incurved and intricately interwoven. Internodes short, straight and occupied for nearly their whole length by a biserial cluster of about five pairs of zoœcia, which gradually increase in length from the proximal to the distal. Two long, hollow, curved processes articulated at the end of each zoœcial cluster.

Port Phillip Heads. Guichen Bay, South Australia, Rev. J. T. Woods. Port Jackson.

This is undoubtedly the *A. cornuta* of Lamaroux, although he only figures a single row of zoœcia; and there is no doubt it is also the species intended by Tenison Woods, but which I wrongly referred in the Zoology of Victoria to that previously described by Goldstein as *A. Woodsii.* It is distinguished by the zoœcia in the clusters increasing slightly in height from the proximal to the distal, and by the peculiar processes from the anterior extremity of the clusters.

11. A. Woodsii, Goldstein.

(Plate B., Fig. 5.)

Amathia Woodsii, Goldstein, Journ. Microsc. Soct. Vict., 1879.

A. Australis, MacGillivrary in McCoy's Prod. Zool. Vict., pl., 185, fig. 5.

Zoarium forming tufts several inches high of dichotomously divided branches. Internodes of moderate length, slightly arched, each occupied for three-fourths of its length by a biserial cluster of 5-7 pairs of zoœcia, diminishing regularly in height from the proximal to the distal; the terminal clusters having beyond the distal zoœcia a pair of large, confervoid and frequently branched processes; and occasionally a similar process replacing a branch at a bifurcation.

Port Phillip Heads. South Australia. Port Jackson. Port Stephen, N.S.W., Baron von Mueller.

At once distinguished by the regularly diminishing clusters of zoœcia and the long branched confervoid processes. One of these processes frequently seems to replace a branch at a bifurcation. They ought possibly to be considered as young or aborted branches.

I regret that I unfortunately overlooked Mr. Goldstein's excellent description and figure when previously describing this species.

13. A. Wilsoni, Kirkpatrick.

(Plate D., Fig. 2.)

Amathia Wilsoni, Kirkpatrick, Ann. and Mag. Nat. Hist., July, 1888.

Zoarium irregularly branched, of a light brown colour. Main stems having in front a biserial cluster of 6-9 pairs of zoœcia occupying the upper part of each internode; at each joint giving off three branches, two lateral and one smaller posterior; the lateral branches divided into (usually) three internodes; the first two internodes almost entirely occupied by a continuous double row of 7-12 pairs of zoœcia and giving off at the joints two aborted branches; the third internode smaller, with the zoœcia less distinct and terminated by three abortive branches or plumose processes which are thick, glassy, divided into two or three internodes and at each joint give off a short pointed process. The posterior branches from the main stem consisting of a single celliferous internode terminated by three abortive branchlets.

Port Philip Heads, Mr. J. Bracebridge Wilson. Encounter Bay, S.A.

This beautiful species cannot be confounded with any other. The lateral branches turned forwards and arching inwards, with the glassy abortive branchlets, give the whole a very elegant plumose appearance. The zoœcia are of considerable length and closely connate. The abortive branchlets, as in fact are also the main stems and other internodes, are hyaline and subtransparent.

14. A. plumosa, MacGillivray.

(Plate C., Fig. 2.)

Amathia plumosa, MacGillivray, Proc. Roy. Soc., Victoria, November, 1889.

Zoarium forming large tufts. Primary branches cylindrical, divided regularly by partitions or joints, destitute of zoœcia. Secondary branches given off at the joints in regular diverging

pairs, each pair from an opposite side of the stem to the succeeding, the zoœcia being turned slightly towards the stems; each branch bifurcates, the internode before bifurcation occupied, except at the basal portion, by a biserial cluster of about six pairs of cylindrical zoœcia and each branch of a bifurcation having a similar or smaller group; each of these branches terminating in a pair of confervoid filaments which again divide at their extremities.

Port Philip Heads.

A beautiful species distinguished from all the others by the barren primary stems and the opposite celliferous branches with the confervoid terminating filaments.

EXPLANATION OF FIGURES.

Plate A.

Fig. 1.—Amathia spiralis, nat. size. Fig. 1*a*.—Portion magnified.

Fig. 2.—A. bicornis, nat. size. Fig. 2*a*.—Portion magnified. Fig. 2*b*.—Group of Zoœcia more highly magnified.

Fig. 3.—A. convoluta, nat. size. Fig. 3*a*.—Portion magnified. Fig. 3*b*.—Another portion of the same.

Fig. 4.—A. tortuosa, nat. size. Fig. 4*a*.—Portion magnified.

Plate B.

Fig. 1.—A. lendigera, nat. size. Fig. 1*a*.—Portion magnified.

Fig. 2.—A. obliqua, nat. size. Fig 2*a*.—Portion magnified.

Fig. 3.—A. Brogniartii, nat. size. Fig. 3*a*.—Portion magnified.

Fig. 4.—A. biseriata, nat. size. Fig. 4*a*.—Portion magnified.

Fig. 5.—A. Woodsii, nat. size. Fig. 5*a*.—Portion magnified.

Plate C.

Fig. 1.—A. pinnata, nat. size. Fig. 1*a*.—Portion magnified.

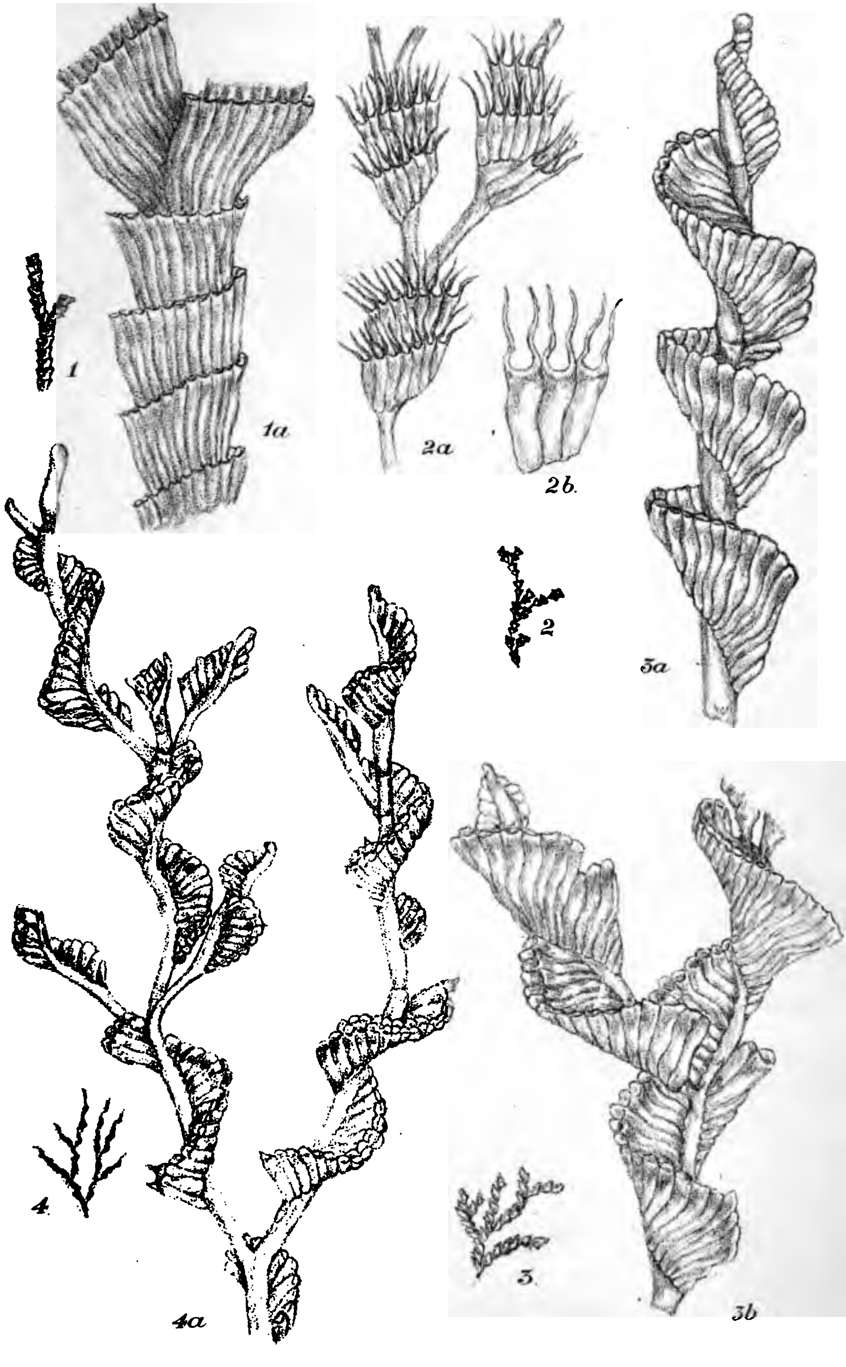
Fig. 2.—A. plumosa, nat. size. Fig. 2*a*.—Portion magnified.

Fig. 3.—A. distans, nat. size. Fig. 3*a*.—Portion magnified.

Plate D.

Fig. 1.—A. cornuta, nat. size. Fig. 1*a*.—Portion magnified.

Fig. 2.—A. Wilsoni, nat. size. Fig. 2*a*.—Portion of anterior aspect of branch magnified. Fig. 2*b*.—Portion of posterior surface of same.



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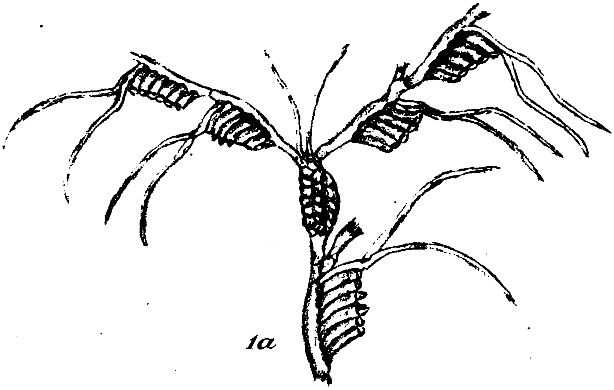

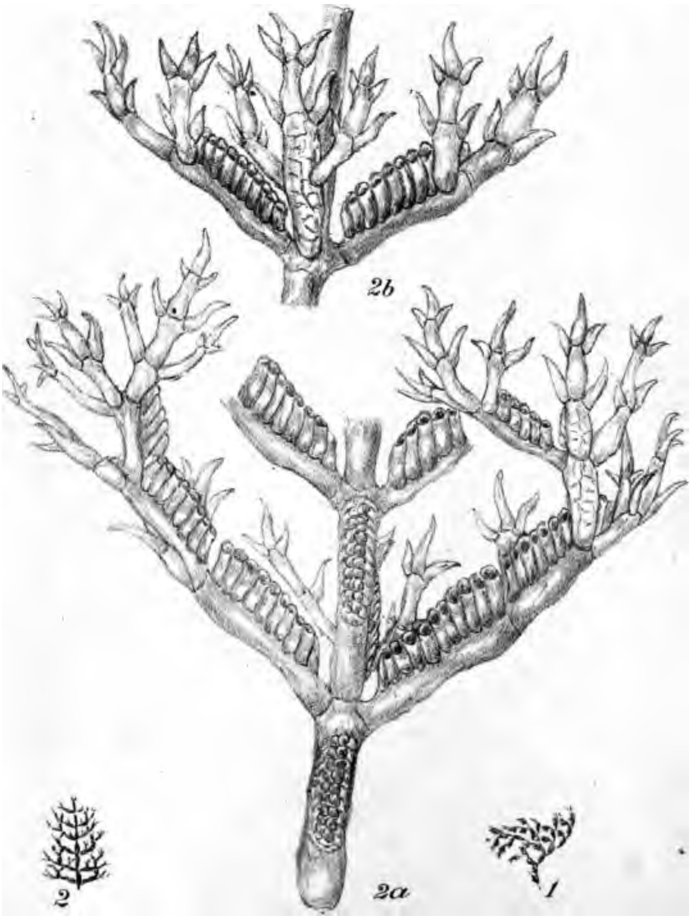

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ART. X.—*On the best Form for a Balance Beam.*

By Professor KERNOT, M.A., C.E.

[Read 12th July, 1894.]

On the 13th May, 1880,* I submitted to this Society a paper on the above subject in which the problem of designing a balance beam of minimum mass for a given strength and rigidity was discussed, and a form was suggested very different from those in general use. This result was arrived at purely by mathematical reasoning. It appeared at the time desirable to verify this reasoning by actual experiment, and models were prepared for the purpose, but the appliances for making the experiments being of a very imperfect kind difficulties arose in making the tests, and the whole matter was laid aside. Recently, however, there has been an opportunity of reopening the question, and with the aid of the large and very perfect testing machine belonging to the Engineering department of the University, a number of experiments have been made which I now propose to describe, and which bear out the conclusions of the paper. Four models were obtained of cast gun metal, and of about the same weight. Two of these represented the form advocated in the paper, while the others represented the type shown by Fig. II. in the diagram (see p. 22, of vol. xvii., Transactions).

The results were as follow, the beams being one foot long :—

	Load at each end of beam at moment of failure.	Ultimate deflection.
1. Design advocated, Fig. 3 of diagram. Weight 12½oz.	... 882lbs. ...	·06 inch.
2. Design advocated, Fig. 3 of diagram. Weight 13¾oz.	... 1035lbs. ...	·07 inch.
3. Old form, Fig. 2 of diagram. Weight 12½ oz.	... 413lbs. ...	.4 inch.

* Transactions of the Royal Society of Victoria, vol. xvii., p. 19.

	Load at each end of beam at moment of failure.	Ultimate deflection.
4. Old form, Fig. 2 of diagram. Weight $12\frac{1}{2}$ oz. ...	495lbs. ...	·5 inch.

In experiment 4 the beam was placed between boards connected by bolts, in order to check a tendency to bend sideways that had been noticed in experiment 3. This precaution led to a considerable increase of strength, as is shown by comparing the results of experiments of 3 and 4.

As the above beams were not all of exactly the same weight the readiest way of determining their relative merits is by finding how many times its own weight each beam carried. These results, obtained by dividing the load carried by the weight of the beam, are: 1131, 1203, 529 and 634 respectively, showing the enormous superiority of the proposed type.

Art. XI.—*Aboriginal Rock Paintings and Carvings in New South Wales.*

(With Plates 8 and 9.)

By R. H. Mathews, Licensed Surveyor.

(Communicated by E. F. J. Love, M.A.)

[Read 12th July, 1894.]

For some time I have been studying the rock paintings and carvings made by the aborigines of New South Wales; and last year I prepared a short paper on the subject, and read it before the Royal Society of New South Wales, of which I am a member. My paper appears in the journal of that Society for 1893, Vol. XXVII., pp. 353-358, with three plates. The paper was read in October last, and was fully reported in the newspapers, by which means a great deal of attention was drawn to rock paintings and carvings, and many persons who had never before given any consideration to the subject were thereby induced to collect information, and make drawings of paintings and carvings visited by them, which have been found valuable to our Society here.

It has, therefore, occurred to me that if the subject were brought before the members of your Society, and publicity given to it, it may have the same effect in your colony. With this object in view I have prepared some drawings of aboriginal paintings in caves or rock shelters, and also a few drawings of native carvings on rocks. It is much to be regretted that this subject has received so little attention from early colonists, who could then have easily obtained authentic information in regard to it. These drawings, though primitive enough in design, and rude in execution, yet are highly interesting to the archæologist and ethnologist.

Most, if not all, of the animals painted or carved upon rocks may have been intended to represent the *totems* of the different divisions of the classes forming the community. It is well known that the Australian tribes were divided into classes, which were

again divided into groups bearing the names of animals, as kangaroo, opossum, iguana, emu, black snake, codfish, etc. The figures of animals and other objects, as well as groups of hands, may also have had some symbolical meaning in connection with the myths and superstitions of the Australian aborigines, or were drawn with the object of conveying some kind of knowledge. These points require further investigation before any conclusion of a definite character can be arrived at.

I will first describe the rock paintings, and the method of producing them, and will then deal in a similar manner with the rock carvings.

Rock Paintings.

Many of the cave paintings of New South Wales consist of representations of the human hand, and these are done in two different ways—one of which has been called the *stencil* method, and the other the *impression* method. The former is the most generally adopted for hand pictures, and is likewise used in many instances in representing implements of the chase.

In *stencilling* figures of the human hand or other objects on the walls and roofs of caves or rock shelters, a smooth surface was selected and slightly wetted or damped with water. The palm of the hand was then placed firmly on the surface of the rock, with the fingers and thumb spread out, and the required colour squirted or blown over it out of the mouth. Probably one native would hold his hand on the rock, and another would apply the colour; but it was quite possible for one operator to do both. Sometimes the part of the hand which was laid on the rock was slightly greased with animal fat to make it fit closely against the stone, and thus prevent the colouring matter getting under it. For the white colours they used pipe-clay, and for the red, red oxide of iron, commonly known as red ochre. I got this information from Mr. John Medhurst, who is now an old man. About the year 1843 or 1844 he was living on Wollombi Creek with his father, and saw the blacks stencilling their hands on the wall of a rock shelter. I asked him if the coloured clay was wetted before being put into the mouth, but he said it was not,—the dampness of the rock makes it adhere, and firmly attach itself to the stone, where it appears to have the durability of an

ordinary pigment. On removing the hand, the space it occupied has the natural colour of the rock, whilst around its margin is smeared with the colour used by the operator. If the object to be drawn be a boomerang, a tomahawk, a waddy, etc., the same course is followed, if this method of producing it be adopted. All the objects shown in Figs. 3 and 4 are drawn in this style, as well as some of those appearing in Figs. 2, 5 and 6, Plate 8.

In the *impression* method before mentioned, the colour to be used was mixed with water, or with bird or fish oil, in a hollow piece of bark, or in a stone with a depression in it, into which the hand was dipped, and then pressed firmly against the surface of the rock, when the impression of the hand was left very clearly. In Fig. 2, the rows of twenty-seven and thirteen hands are done in this way, the remaining seven being stencilled. I have never seen or heard of any figures except the hand having been executed in this method. Mr. W. E. Armit, a writer in Curr's *Australian Race*, Vol. II., p. 301, says—"I have often myself seen the blacks on the Leichhardt River, Queensland, imprint their hands, stained with red ochre, on rocks and trees, and I cannot accept such marks as a proof of antiquity."

In the districts visited by me in collecting information on this subject, I have found impressed hands in comparatively few caves, the stencil method being that generally adopted. Perhaps the work was more easily done in the latter style—there being no necessity for preparing and mixing the colour; or, it may be that impressed hands had some particular meaning.

Native pictures of men, animals, and other objects, to which neither of the preceding methods would be applicable, are drawn in *outline* in various colours. In these cases the colours used are mixed with bird or fish oil, or the fat of some animal; pipe-clay and red ochre being used for white and red, respectively; and where black was required, it was made from ground charcoal, or soot, similarly mixed with grease. Mixing the colours with an oily or fatty substance caused them to penetrate the surface of the rock, and become very durable. In some cases the figures were merely outlined, as in Fig. 6, in others as in Fig. 1, they were shown in solid colour all over; whilst in others the space within the margin of the outlines was shaded by strokes of

the same, or a different colour. See Plate XIX., *Jour. Roy. Soc. N.S.W.*, Vol. XXVII.

I have visited between fifty and sixty rock shelters containing native drawings, and only in a few of them have I found yellow colour employed, and then only for some small figures. The reason for this is that yellow clays are not plentiful. Blue colour is still scarcer, and I have only observed its use in one cave.

Vegetable colours were also known to the aborigines. E. Stephens says they painted red bands on their shields by means of the juice of a small tuber, which grew in abundance in the bush.—*Jour. Roy. Soc. N.S.W.*, XXIII., p. 487. The apple tree, and also the grass tree, of Australia, yield a red gum or resin, which has the property of staining anything a red colour.

Rock Carvings.

Whilst I was engaged in visiting a group of native carvings on a tributary of Broken Bay, I came upon some which had been partially carried out and then abandoned, which disclosed to me the method the native artist employed in producing the work. A number of holes were first made close together along the outline of the figure to be drawn, and these were afterwards connected by cutting out the intervening spaces, thus making a continuous groove. It is probable that the object was first outlined by drawing a piece of coloured stone or hard pebble along the line to be cut out. Judging by the punctured indentations made in the rock in cutting out the lines of these figures, I conclude that the natives used a hard pebble ground to a point, and used as a chisel. As soon as the outline of the figure was chiselled out to the required depth, I think the remainder of the work was done with a stone tomahawk. I am led to this conclusion because the sides of the groove are cut more evenly than could have been done with such an instrument as the holes were punctured with; and there is no doubt the work could thus be done with greater expedition. From the smoothness of the edges of these grooves in a few of the best executed figures, I am inclined to believe that, after the chopping out was finished, the edges were ground down by rubbing a stone along them. In

support of these conclusions I may state that close to the figure shown in Plate IX., Fig. 7, I found a sandstone rock which had been used by the aborigines for grinding their stone weapons. I observed places hollowed out by sharpening tomahawks, and near them were much narrower hollows in which it was evident some pointed instrument had been ground. I saw the same thing on a rock close by where the figure shown in Fig. 8 is depicted. The carvings of men and other objects are generally found on horizontal surfaces of sandstone rocks, which are numerous for many miles around Sydney; but are sometimes seen on the walls of rocks occupying a perpendicular position.

As regards the age of these drawings, some wild and fanciful hypotheses have been propounded by some writers, but from the facts set forth in this paper it must be conceded that the practice of painting rocks was in vogue among the aborigines at the time the white people first settled in New South Wales.

With respect to the rock carvings, so far as I am aware at present, they have not been observed by any European in course of production, but, nevertheless, I am not inclined to attach any great antiquity to them. As far as I have been able to learn, these carvings have not been observed in any other part of New South Wales, except within a radius of about fifty miles from Sydney. This point is not, however, definitely settled. I am making enquiries through correspondents in different parts of the colony, with a view of ascertaining if the practice has been observed elsewhere.

Mr. Ernest Favenc, who has travelled a great deal in Western Australia, informs me that, in the Murchison District of that colony, he found gigantic representations of a human foot, and and other marks, scratched upon granite rocks by the aborigines. These scratchings were not deep, owing to the extreme hardness of the stone, and appeared to have been worn out by repeated rubbing, probably with a very hard pebble, along the outlines drawn on the rock. All the figures of feet seen by Mr. Favenc had six toes.

Mr. W. Y. L. Brown, Government Geologist, Adelaide, states that he has seen at Paratoo and Oulnina, South Australia, representations of the feet of kangaroos delineated in outline on the surface of the rocks by some sharp instrument; and at

Blanchewater, also in South Australia, he saw similar outlines of human feet, in addition to those of the kangaroo.

Mr. Arthur J. Giles, in 1873, discovered at the junction of Sullivan's Creek with the Finke River, South Australia, carvings cut from a quarter to half an inch deep into the face of a cliff of hard metamorphic slate. The carvings consisted of perpendicular grooves, about an inch and a half wide, besides other minor devices.

Mr. Henry Tryon describes, what he calls, some "rock engravings" on Pigeon Creek, on the bridle path from Tenthill to Pilton, Queensland. In an outcrop of sandstone there is a cave or rock-shelter, on the walls of which figures are cut, in some cases to the depth of an inch; whilst some are merely scored on the rock.—*Proc. Roy. Soc. Q.*, Vol. I., pp. 45-52, plates xi. to xiii.

It will thus be seen that carvings of a rude and elementary character have been observed in Western Australia, South Australia and Queensland, whilst in the district around Sydney, New South Wales, they are better executed, and are on a more extensive scale. This would seem to indicate that the natives of the eastern coast had perhaps been influenced by a higher race, such as the Malay or a kindred people.

If any of the members of your Society, who hear this paper read, or who may see the report of it in your Journal, know of any rock paintings or rock carvings in Victoria, or elsewhere, I would ask them, in the interests of science, to collect all the facts they can, and either bring the matter before your Society, or communicate with me.

DESCRIPTIONS.

I will now proceed with the descriptions of the figures shown in Plates VIII. and IX., annexed to this paper:—

Plate VIII., Fig. 1.—The cave or rock-shelter containing these drawings is situated in an escarpment of Hawkesbury sandstone, about 5 chains north from portion No. 33, of 40 acres, in the Parish of Wareng, County of Hunter. The length of the cave is 16 feet; height, 6 feet 6 inches; and the depth from the entrance to the back wall, 11 feet 6 inches. The front of the shelter faces S. 20° W.

The paintings, which are all drawn in solid black, consist of two human figures, the tallest one measuring 2 feet 3 inches from the feet to the hands; the smaller one measuring 1 foot 9 inches, and having appendages on the ears or sides of the head resembling those seen in Fig. 7. The other figures are a kangaroo jumping; a dog; two birds; two figures, which appear to be intended for eels; a boomerang; what appears to be designed to indicate the track of an emu; and near the tail of the kangaroo is a figure which appears to be intended for a bird, or flying squirrel, on the wing.

Plate VIII., Fig. 2.—This shelter is 28 feet long, 18 feet high, 11 feet from front to back, and faces north-east. It is on the end of a rocky point reaching into a sharp bend in Cox's Creek, about 2 chains from the eastern boundary of Portion No. 65, of 40 acres, in the Parish of Coolcalwin, County of Phillip. All the drawings are in red colour.

The total number of hands delineated in this shelter is 96, besides other objects, but I have only shown 40 impressed hands and 7 stencilled ones; of the former there are two, and of the latter four, left hands. There are two waddies represented; one of which, four feet long, being stencilled; and the other, 3 feet 7 inches long, drawn. A circular figure, 3 feet by 2 feet 9 inches, with a line leading from it to the stencilled waddy, completes the paintings shown on this Fig.

Plate VIII., Fig. 3.—This cave or rock shelter is situated in an escarpment of Hawkesbury sandstone within Portion No. 81, of 108 acres, in the Parish of Bulga, County of Hunter, and faces N. 20° W. Its length is 54 feet, depth from the front inwards 11 feet, and its height varies from 6 feet 6 inches to 4 feet 6 inches, the floor being irregular.

This Fig. shows seven representations of waddies, two tomahawks, two boomerangs, eight hands, and a figure which appears to be intended for the head of a tomahawk without the handle. Two out of the eight are right hands. All the figures are stencilled in white on the natural surface of the sandstone. This cave contains twenty-six hands altogether, besides other objects, but I have given the most interesting group in this Fig.

Plate VIII., Fig. 4.—This small cave is in a sandstone rock facing N. 25° E., a short distance from the southern shore of Red Hand Bay, a tributary of Middle Harbour, near Sydney.

Its length is 6 feet, depth inwards 3 feet 9 inches, and height 3 feet 4 inches.

The paintings consist of six right hands, two of them being children's; three left hands; and three right feet, two of which are those of children. All these figures are done in white stencilling. It may be stated that representations of feet are uncommon, and are only met with occasionally.

Plate VIII., Fig. 5.—This large rock shelter is situated in an escarpment of sandstone rock, about three-quarters of a mile southerly from Portion No. 4, of 40 acres, in the Parish of Wilpinjong, County of Phillip. Its length is 79 feet, 25 feet deep from the front inwards, 6 feet 6 inches high where the roof meets the back wall, and increases in height outwards towards the front. The cave faces the north-east.

The drawings in this large cave are very numerous and comprise various objects, but the Fig. shows one of the most interesting groups, which is on the roof of the cave. On the left are an iguana and a snake, each about 3 feet 3 inches long with their heads in opposite directions. Above these are two drawings which appear to have been intended to represent the sun, one having eighteen rays and the other thirteen. The larger is eighteen inches in diameter, and the smaller one foot. On the right hand side of the Fig. is a circular object, six inches in diameter, which may have been drawn to indicate the moon. On the right of this figure are three crosses, which suggest the supposition that they were intended for stars. "The Bushmen of the Kalahari Desert in South Africa decorate the walls of their dwellings with the representations of quadrupeds, tortoises, lizards, snakes, fights, hunts, and the different heavenly bodies. The drawings made inside caves are chiefly upon sandstone in ochres of various colours."—*Anth. Jour.*,* X., 460. Extending from the circular object towards the snake are fifteen tracks in red, of a bird's foot, to another small cross. At the commencement of these tracks, and above them, are three similar tracks drawn in white colour, as if to distinguish them from the others. A short distance below all the foregoing figures are fourteen

* Throughout this paper I have used this contraction for the "Journal of the Anthropological Institute of Great Britain and Ireland."

stencilled hands, the right and left being equally represented. Four of these are the hands of children, and two show the hand in the shut position, which is very uncommon. All the figures shown on this Fig. are drawn in red colour, except the three tracks of a bird above referred to.

Plate VIII., Fig. 6.—This cave or rock shelter is 44 feet long, 23 feet deep inwards from the front, and varies from 5 feet to 8 feet high, owing to inequalities of the roof; and faces S.50° E. It is about 8 chains westerly from the western boundary of Portion No. 42, of 120 acres, in the Parish of Tollagong, County of Hunter. It occupies the base of a mural precipice, having been worn out by fluviatile action and atmospheric influences. The roof is begrimed with the smoke of numerous fires, and the shelter appears to have been used as a camping place by the aborigines for many generations.

The drawings in this cave are numerous, and of great interest, but the Fig. shows only one of the groups. The first object on the left of this Fig. appears to be intended for a native bear; then follow the figures of four iguanas, the largest of them being 3 feet 6 inches long; and lastly three stencilled representations of the left hand. All these drawings are in white.

Another group of drawings in this cave comprises two blackfellows and their gins, there being an interval of about 5 feet between each couple. The male figures are considerably the larger in each instance. This group has been included in a paper which I am preparing to read before the Royal Society of New South Wales, on an early date.

Plate IX., Fig. 7.—This gigantic figure of a man is carved on a flat rock of Hawkesbury sandstone on the top of a high range, overlooking Cowan Creek, a tributary of the Hawkesbury River, and is about a chain and three-quarters from Tabor Trigonometrical Station. The height from the feet to the top of the head is 9 feet 8 inches, and the width across the body 3 feet 9 inches. There is a forehead band in which some ornaments are stuck, or they are attached to the ears. "In some tribes feathers of the owl and the emu were fastened to the forehead and ears."—*Anth. Jour.*, XX., p. 85. In the right hand is a club, 2 feet 6 inches long, with another, 2 feet long, lying close by; in the left hand is a shield, 3 feet 8 inches long, and 1 foot 8 inches across the

middle. The eyes, nose and mouth are shown—the latter rather to one side. In the belt, around the waist, some object appears to be carried, resembling the end of a boomerang, although the part below the belt is not shown. It is well known that boomerangs were sometimes so carried.—*Aborigines of Victoria*, I., p. 132 and p. 277. One of the feet has six toes, and the other only four. Within the outline of the man is a subordinate carving which I am unable to identify. This figure appears to have been designed to represent an aboriginal warrior, with his clubs, shield, and boomerang, having his head decorated in the usual manner. After the ceremony of the *Bora* the young men were "invested with the belt of manhood . . . the forehead band . . . and the full male dress."—*Anth. Jour.*, XIV., p. 311. In Collins' *Account of the English Colony of N.S. Wales*, pp. 365-374, he states that at the conclusion of a *Bora*, which he witnessed, each young man had "a girdle tied round his waist, in which was stuck a wooden sword; a ligature was put round his head, in which was placed slips of grass-tree, which had a curious effect." In Henderson's *Observations on the Colonies of N.S.W. and V.D.L.*, pp. 145-148, it is said that after a young man had passed through the ceremonies of the *Bora*, "he was permitted to wear a girdle, and to carry the spear and other war arms, like men."

My comparison of the dress of this chief to the dress worn by the blacks who have been initiated is merely to show the sort of dress worn by the men on ceremonial occasions. I do not mean that this figure represents a man who has just been initiated,—or that it necessarily has anything to do with the *Bora*.

All the lines on this Fig. are cut into the rock in the manner described at page 146 of this Paper, and are about half an inch deep, and an inch and a quarter wide, and are well finished.

Plate IX., Fig 8.—This group of carvings is on a flat sandstone rock on the western side of the track from Pymble to Cowan Creek, a tributary of the Hawkesbury River, about half a mile southerly from Bobbin Trigonometrical Station.

The carving represents a man and woman in the attitude assumed by the natives in dancing a corroboree. The eyes and mouth are delineated, but the nose is missing in both. Each has the belt round the waist, and the male figure has a band around the arms near the shoulder. See *Anth. Jour.*, XIV., p. 311. The

male figure is very much the largest, and this disparity in the sizes of men and women is found in all the paintings, as well as carvings, which have come under my notice. Seventeen ray-like lines rise from the head of the man—and eight from the head of the woman—which may either be intended for hair, or ornaments stuck in it. To the left of these figures is a carving evidently intended to represent a native bag, but it is drawn out of proportion to the human figures. The remainder of the group consists of four large rudely carved representations of feet.

Plate IX., Fig. 9.—This Fig. shows two representations of figures of iguanas or crocodiles. One is carved on a flat rock on Portion No. 1140, of 40 acres, in the Parish of Manly Cove, County of Cumberland. It is 6 feet 7 inches long, and 9½ inches across the widest part of the body; the legs have no claws upon them, and the head is bent as if the animal were looking about. Round the body are three bands similar to those found on the bodies of men and women, which would lead us to suppose that this animal was reverenced by the natives or their forefathers, and would perhaps suggest a Sumatran origin of the tribes who executed these drawings. These bands may have been intended to indicate the stripes seen on the bodies of iguanas. The other is carved on a flat sandstone rock not far from the group shown in Fig. 8, and is 7 feet 2 inches long, and 13½ inches across the body. An eye is shown, and the claws are not forgotten.

Plate IX., Fig. 10.—This carving is situated on Portion No. 1139, of 24½ acres, Parish of Manly Cove, County of Cumberland. The larger figure of this group does not resemble any known animal, and appears to represent some monster of the native artist's fancy. A human figure appears on the body of this animal which is, in my opinion, a separate picture drawn there before or after the other one, owing to the suitability of the surface; the same may be said of the object below the left foot of the human figure. It is not uncommon to find small carvings within the outlines of larger figures in this way.

Plate IX., Fig. 11.—This Fig., which is on the same rocks as Fig. 10, shows the outline of a young female, 3 feet 7 inches

high. The drawings of full-grown women always have the teats delineated, whether in paintings or carvings.

Plate IX., Fig. 12 is on the same rock as Fig. 10 and 11, and, I think there can be no doubt that it represents the native dog. It is three feet six inches long, and stands about 1 foot 8 inches high.

Plate IX., Fig. 13 is an average specimen of the kangaroos carved on rocks, both as regards size and style of work. This figure is on a large flat rock sloping slightly northerly, near the southern boundary of Portion No. 717, Parish of Manly Cove, County of Cumberland.

Plate IX., Fig. 14.—This group is on a flat rock about twenty-eight yards south-westerly from Fig. 8. It includes an emu about seven feet nine inches from the point of its bill to the end of its tail, and about five feet three inches high. Only one leg is drawn, and the foot is a straight continuation of the leg, a mode of drawing I have before found in native figures of emus. There are two human figures, with their heads in contrary directions; they both have belts round the waist and bands round their ankles. The latter are unusual, and have not been seen by me in other carvings. Sir George Grey, in his *Two Expeditions in N.W. and W. Australia*, II., p. 250, says that strings made of the fur of the opossum were tied like bracelets round the wrists and ankles. The feet of the smaller figure are turned inwards, which is the only case where I have observed this —the toes usually pointing outwards, as in the other figures shown on the Plate; a representation of hair is also shown on the head, as in Fig. 8. The larger figure has what appears to be intended for a spear or club in his hand, only a small part of the weapon being shown. It will be observed that the line which forms the head of the larger human figure, also serves to mark out the tail of the emu. There is an oval-shaped hollow in the rock (see Fig.) which was, I think, naturally there, in which water lies during the winter, and after rain in the summer, so that if the lines of the figures were originally continued through this hollow, they have long since wasted away. I have shown by dotted lines where it is probable grooves formerly existed.

Plate IX., Fig. 15.—This carving of a gigantic fish is found upon a large flat sandstone rock, on Portion, No. 83, of 320 acres,

in the Parish of Narrabeen, County of Cumberland. It is 42 feet 6 inches long, and upwards of 12 feet across the widest part of the body, not including the fins. The mouth is open, the upper jaw being 2 feet 7 inches long, and the lower 2 feet. Both eyes are shown on the same side of the head—a common practice among the blacks when drawing representations of fish. This fish has a pectoral, a ventral, and two dorsal fins. Sir Charles Nicholson describes a carving of a large fish at Middle Head, Port Jackson, which was "upwards of 30 feet long."—*Anth. Jour.*, IX., p. 31. In the *Records of the Geological Survey of N.S.W.*, Vol. II., p. 178, Mr. Etheridge describes a large fish 31 feet 9 inches long, carved on a flat rock, near Manly, not far from Sydney. The carving which I have shown in Fig. 15, is, therefore, 10 feet 9 inches longer than any drawing of a fish hitherto recorded.

It is not improbable that this large fish was intended for the porpoise, which was venerated all along the eastern coast from Gippsland to Newcastle. It was a common practice with the aborigines to draw on a large scale any animal they wished to honour. On one of their *Bora* grounds I found a horizontal figure of Baiamai, 20 feet long, formed of raised earth on the surface of the ground.

General.

All the figures shown on the plates are drawn to scale, and are accurately reproduced from measurements taken by me with a tape measure in every instance; the directions which the shelters face were taken with a pocket compass. The position of each painting and carving on the Government maps is also given, so that they can be found by anyone wishing to see them.

In the newspaper report of the expedition fitted out by Mr. W. A. Horn, for the scientific exploration of the McDonnell Ranges in Central Australia, it has amongst its objects—"the reproduction by photography of aboriginal paintings in caves and on rocks."

Rock paintings by the aborigines have been observed from the time of the earliest explorers, and are universally distributed over Australia, having been noticed in all the colonies at places far apart, but there has, hitherto, been very little attention paid to them. These paintings have frequently been seen in different

parts of Western Australia, South Australia, Queensland, and New South Wales, but are not well known in Victoria. Mr Curr, in his work on *The Australian Race*, vol. i., p. 9 states "In the Victorian Valley, Victoria, there is, I have often heard, a cavern, the roof of which is covered with old aboriginal paintings. The roof is said to be several feet from the ground, and out of reach." Caves whose painted roofs are at present out of reach are not uncommon, and have been met with by me,—the reason of this is that the floors have been wasted away by the action of the weather.

From enquiries I have myself made, I learn that there are caves containing aboriginal *paintings* on the western side of the Victoria Range, County of Dundas; and also on the north-eastern side of the Grampians, County of Borung. The railway runs within easy distances of both these localities, so that any gentlemen capable of copying these cave paintings could easily visit the districts in which they are to be found. I have, no doubt, that upon arriving in that part of the country, numbers of similar caves would be heard of by making enquiries from old residents. I hope someone will take sufficient interest in this matter to go into the districts indicated, and that his visit will result in the preparation of a paper on the subject to be read before your Society. Anyone going into that part of the country ought also to enquire if any aboriginal *carvings*, similar in character to those described in this paper, have ever been observed upon the surfaces of sandstone rocks. As far as I have been able to learn, none of these rock carvings have hitherto been observed in any part of Victoria; but I can see no reason why they should not be found there, and ought, therefore, to be searched for. Localities abounding in large flat masses of sandstone rocks, with smooth surfaces, are the likeliest places to find these carvings.

Enquiries ought to be made in different parts of Victoria, besides those I have mentioned, in the hope of hearing of other cave paintings.

I have contributed this paper on the Rock Paintings and Carvings of New South Wales, in the hope of adding to the scanty literature of a subject which is one of those having very great interest to the anthropologist, as well as to the historic and classical student.

ART. XII.—*Note on the Occurrence of Fossil Bones at Werribee.*

By G. B. PRITCHARD.

[Read 12th July, 1894.]

A short time ago having heard that some bones had been discovered during the excavation of the drains for the Werribee Sewage Farm, by the Metropolitan Board of Works, I called upon Mr. C. E. Oliver, M.C.E., Superintending Engineer of Sewerage, in whose possession the fossils were, and through his kindness and courtesy I was allowed the privilege of an examination which resulted in their identification. These identifications I now wish to place on record.

PHASCOLOMYS PLIOCENUS, McCoy.

The first specimen is the lower jaw of the extinct wombat, *Phascolomys pliocenus*, *McCoy*, which agreed remarkably well with the admirable figure and description given by Sir F. McCoy in the Prodromus of the Palæontology of Victoria, Decade I., p. 21, plates III., IV., V. This specimen was in an excellent state of preservation, the only flaws being the absence of portions of the ascending rami and the distal ends of the two incisors, the cause being no doubt due to insufficient care being exerted during its excavation. In the Prodromus, this species is recorded from the gold drift of Dunolly, and from the shores of Lake Bullen Merri, Camperdown. In an essay "On the recent Zoology and Palæontology of Victoria," by Sir F. McCoy,* it is further recorded from the red clays of Lake Timboon. By examining the specimens in the National Museum, Melbourne, the following additional localities may be noted:—Limeburners Point, Geelong; Modewarre, Geelong; Bet-Bet, near Avoca; and a half of a lower jaw has been picked up on the beach two miles west of the Werribee River.

? PALORCHESTES AZAEL, Owen.

The second specimen was in a very fragmentary condition when it came into my hands, having been badly broken by the

* Intercolonial Exhibition Essays, 1866-67, p. 15.

pick; however, as all the fragments appeared to belong to the one bone, an endeavour was made by Mr. T. S. Hall and myself to piece them together, which was, we were glad to find, eventually successful. This proved to be the *tibia* of the gigantic extinct kangaroo, for which the genus *Palorchestes* was founded by Sir Richard Owen. The first specimen which came under the notice of that distinguished authority, was a portion of a skull discovered in 1851, by Dr. Ludwig Becker, "in a bed of yellowish sand and clay, mixed with very small shells, in the Province of Victoria, Australia."

A fragment eight and a half inches in length of the proximal end of a tibia, referred to this genus, is described and figured in the Philosophical Transactions,* and in Owen's "Fossil Mammals of Australia," p. 495, pl. cxxxi., and with this as far as it goes our example agrees accurately, the latter, however, is quite twenty-four inches in length, and is about five inches in circumference at its narrowest part. I refer this example to the above species with but little doubt, as it is the type and only species of the genus, and Mr. R. Lydekker says† it "is the largest known member of the family (*Macropodidæ*), the length of the entire cranium being estimated at sixteen inches," and on account of the very large size of the skull he further remarks‡ that this "indicates that the largest limb bones probably belongs to that genus."

Judging from the specimens recorded by Sir R. Owen in the works cited above, and by R. Lydekker, in the British Museum Catalogue,§ we are fortunate in possessing such a fine example of this bone.

The exact locality from which the above bones have been procured was given me by Mr. C. E. Oliver, and is the Werribee Sewage Farm, 2 miles 39 chains 87 links on drain 55 east, 3 feet below the surface in a slightly calcareous red sandy clay.

Both specimens are now in the Biological Museum at the University.

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* Phil. Trans., 1876, p. 203, pl. xxiv.

† Brit. Mus. Cat. Fossil Mammalia, part v., p. 237.

‡ *Op. cit.*, p. 239.

§ *Op. cit.*, p. 244.

Art. XIII.—*The Entomogenous Fungi of Victoria.*

By D. McAlpine and W. H. F. Hill.

[Read 9th August, 1894.]

I.

Introductory.

Entomogenous Fungi, or fungi parasitic upon insects, have not hitherto received the attention in this colony which their importance deserves. Only eleven species are recorded for Australia, and six of these belong to Victoria, and yet there are quite a number awaiting the attention of the patient investigator. Dr. Cooke, in his *Handbook of Australian Fungi*, and in his popular volume on *Vegetable Wasps and Plant Worms*, has given us a more or less full account of these; but to anyone willing to take up the subject, there is a wide field for extended observation and description on the spot. We have attempted a beginning by way of extending our knowledge in this fascinating region, and trust that mycologists and entomologists may combine in unearthing the numerous forms of Entomogenous Fungi, which seem to flourish unrecorded in our midst. The subject has a dual aspect, as the name denotes. There is the entomological side in which the insects attacked by fungi are considered, and the mycological side in which the fungi attacking the insects are studied. To do full justice to the subject, both sides have to receive attention, the nature and habits of the insect being necessary for the proper understanding of the life-history of the fungus, and the fungi themselves vary according to the habits of the insects attacked. One of us is mainly responsible for the mycological portion, while the other has made careful study of the entomological part.

In addition to the entomological and mycological aspect, there is also an economic one, for apart altogether from the scientific investigation of these fungus-bearing insects and insect-destroying fungi, the subject has very important practical bearings. Every one is familiar with the common house-fly, transfixed to the

window pane or other smooth surface, with a white halo around the body, caused by the fly-mould known as *Empusa Muscae*, Cohn; and the muscardine or silk-worm disease is also well known, whereby the silk-worms become mummified, as it were, and so hard as to snap when bent. This is caused by a white mould known as *Botrytis Bassiana*, Bals., which fills, absorbs and destroys the interior of the caterpillar, and appears on the surface as a woolly covering. It would be out of place here to pursue this subject further, but it may be noticed that the coccus of the orange, the locust, and the aphides or plant-lice have all their parasitic fungi, and it has been proposed in the case of the latter to use the fungus for reducing their numbers. *Botrytis tenella*, Sacc., is known to be very destructive to the larvæ of the cockchafer (*Melolontha vulgaris*) which is recognised in Britain as the most injurious of beetles to the agriculturist; but, perhaps, the most striking instance is that of the mealy isaria (*Isaria farinosa*, Fries.), which is a parasite of the *Cochylis ambiguella*, or raisin-worm as it is commonly called, and after the phylloxera, is one of the most destructive insects to the vine. M. Duchartre drew particular attention, in the Academy of France, last year to a communication from MM. Sauvageau and Perrand recording experiments on the destruction of the insects by means of the spores of the parasitic fungus. In the course of a few days all the larvæ became infected with the fungus and were mummified by it. Similar experiments tried in the vineyard gave a mortality of fifty per cent., and the spores were simply mixed with water and sprayed upon the vines. This pitting of nature against itself opens up a wide field for the destruction of injurious insects, as well as of other pests.

Even the element of romance is not wanting in connection with some of these forms, giving rise to wonderful tales of the transformation of plants into insects, and *vice versâ*. The famous Chinese plant-worm *Cordyceps sinensis*, Berk.) is mentioned by Dr. Pereira in his Materia Medica* as "summer plant, winter worm," and is reputed to possess wonderful medical properties. The whole subject is teeming with interest, and well deserves attention from the biological point of view.

* Materia Medica, vol. ii., 51 (4th ed.), 1853.

Species Recorded for Victoria.

At present there are not many species of Entomogenous Fungi recorded as belonging to Australia. There are eleven species belonging to six genera altogether, and of these six species are found in Victoria, classified as follows :—

Group—Pyrenomycetes.

Order—Hypocreaceæ.

1. Cordyceps entomorrhiza, *Fries.*—Larvæ of insects *(Lepidoptera).*

1A. Cordyceps entomorrhiza, var. Menesteridis, Berk. and Muell.—Larva of *Menesteris laticollis.*

2. Cordyceps Gunnii, Berk.—Larva of some *Cossus* or *Hepialus.*

3. Cordyceps Taylori, *Sacc.*—Larvæ of insects.

Group—Phycomycetes.

Order—Entomophthoraceæ.

4. Empusa Muscae, Cohn.—Bodies of dead house-flies *(Musca-domestica)* and other dipterous insects.

Group—Hyphomycetes.

Order—Stilbeaceæ.

5. Stilbum Formicarum, Cooke and Mass. — Dead ants *(Formica).*

6. Isaria Cicadae, Miq.—Cicada.

In addition to the one described in this paper, several are awaiting determination, and very probably the number will be considerably added to when careful search is made for them.

Literature and References.

The literature referring to the preceding species is rather scanty, and may be given in its entirety :—

1. Berkeley (M. J.)—"On some Entomogenous Sphæriæ." Hook, Lond. Journ. Bot. II., 1843.

Cordyceps Taylori is described and figured.

2. Berkeley (M. J.)—"On some Entomogenous Sphæriæ." Hook, Lond. Jour. Bot. VII., 563, 1848.

C. Gunnii noted.

3. Berkeley (M. J.)—" On some Entomogenous Sphæriæ." Jour. Linn. Soc. I., 1856.

Cordyceps Gunnii and *C. Taylori* mentioned.

4. Berkeley (M. J.)—"Gardener's Chronicle." 791, 1878.
   Description of *Cordyceps Menesteridis.*
5. Cooke (M. C.)—"Australian Fungi." Grev. XVIII., 8, 1889.
   Description of *Stilbum Formicarum.*
6. Cooke (M. C.)—"Handbook of Australian Fungi." London, 1892.
   Contains a technical description of all the Victorian species, with the exception of *Cordyceps Taylori.*
7. Cooke (M. C.)—"Vegetable Wasps and Plant Worms." S.P.C.K., London, 1892.
   This is a popular account of fungi parasitic upon insects, and may be taken as a record of all known up to date.
8. Saccardo (P. A.)—"Sylloge Fungorum," I.-X. vols. Padua, 1882-92.
   Contain description of all known fungi, including those of Australia.
9. Tisdall (H. T.)—"A Curious Fungus." Vict. Nat. VI., 1889.
   Species of *Cordyceps* growing from an ant *(Formica corisobrina)* and found by Mr. C. French, F.L.S.
10. Tisdall (H. T.)—"On a species of *Isaria.*" Vict. Nat. X., 1893.
    Found on a cocoon supposed to be that of the moth, *Darala ocellata.*

NOTES ON LIFE HISTORY OF INSECT.

ONCOPTERA INTRICATA, Walker.

1. Ova.

   Ovæ, taken from ovary, smooth, yellowish-brown, oval, about ·6 mm. diameter.

2. Larva.

   Length, 5½ cm.

   Head, black and polished.

   Thoracic segments, black and hairless. First segment, a plain indurated collar. Second and third, plated with conspicuous, polished, chitinous prominences, arranged transversely.

Abdominal segments, nearly hairless, greenish-black with the exception of the tenth or terminal segment, which is distinctly black and polished.

The first and second are encircled by eighteen small rounded chitinous studs; the third, fourth, fifth, and sixth segments have each twelve; the seventh and eighth have sixteen; and the ninth has fourteen similar studs.

Habits.

The larva appears to be strictly nocturnal in its habits, and is usually found in low-lying country.

During the day time it hides in a little tunnel-like nest, made amongst the roots of a grass tussock. In connection with the nest the insect bores a vertical shaft, some six or eight inches deep, down which it retreats when alarmed.

Prior to its pupation, which takes place in July or August, the larva makes a vertical addition to its shaft, extending it upwards for an inch or two above the surface of the ground.

Specimens of these extensions are on the table, and may be seen to consist of a silk tube, 8 mm. in diameter, strengthened by an outer covering of grass, varying considerably, both in quantity of material, and mode of construction.

3. Pupa.

Red-brown, thorax and wing-cases darker, 25×6 mm., cylindrical, terminating abruptly.

When touched it shows great irritation and wriggles violently.

Ventral side of abdomen furnished with about thirty bristles, 3 mm. long, arranged nearly at right angles to the body, in three longitudinal lines, one median and two lateral.

The eighth segment projects slightly on the ventral side, bearing a hardened plate, set downwards at an angle of 45° with the body.

This organ, with the bristles on the ventral, and the adminiculæ on the dorsal surfaces, are probably of

use to the pupa in working its way from its underground retreat to the surface when about to emerge.

4. Imago.

Oncoptera intricata, Walk. (*Oncopera intricata*, Walk). Bombyces, 1559.

Hepialus fasciculatus, ib. Char. Und. Lep. (1869).

Oncoptera intricata, Meyr. Proc. Linn. Soc. N.S.W., 1124 (1889).

Mr. Meyrick gives the following description of the insect:—

"Male, 31-41 mm.; Female, 48 mm.

"Head, antennæ, thorax and abdomen, fuscous or ochreous "fuscous.

"Forewings sub-oblong, posteriorly somewhat dilated, "costa slightly arched, apex rounded, hindmargin "rounded obliquely, continuously with inner margin "ochreous, ochreous brown, slaty-grey, or dark fuscous; "generally more or less distinctly marbled with "irregular paler or whitish markings, including "rounded darker spots, sometimes marked with "blackish, but these markings are sometimes wholly "confused or obsolete; a pale oblique mark from "inner margin near base, margined on each side with "blackish, is generally conspicuous, but sometimes "obsolete; cilia with basal half ochreous brown, "terminal half white, sharply barred with dark "fuscous.

"Hindwings rather dark fuscous; costa in male suffused "with whitish ochreous or yellow ochreous, cilia as in "forewings.

"A very variable moth, but the basal mark is a good "characteristic.

"Posterior tibiæ in the male have long curved tufts of "hair, rising from above near base, and lying along "abdomen."

The perfect insect appears from the middle of September to the end of October, flying rapidly over the grass during the evening.

Systematic Description of Fungus.

Isaria Oncopteræ, McAlp. (n.s.).

This fungus attacks the larvæ of *Oncoptera intricata*, Walk. About twenty specimens were found near Melbourne, between August and October, inside the grassy tubes made by the larvæ, and in every case either on a level with the surface, or above it. All the infected larvæ observed were nearly full grown and dead, but in no instance were they found dead below the surface of the ground, although many tubes were examined, the larvæ being always alive and apparently healthy when found below the surface. The earliest stage at which the fungus was apparent was when it had killed the grub and filled its body with a mass of soft pithy mycelium of a pale yellowish colour, and covered the outside with a layer of ochrey down, consisting of hyphæ, and having no spores visible. In a day or two, when the specimen was kept in a moist atmosphere, little white processes burst through the skin, irregularly all over the body, increasing rapidly in length, and becoming purplish-pink, except at the apex which remained white. These processes—the stromæ—have a tendency to grow upwards, irrespective of the position of the dead larva. As many as fourteen stromæ grew from one specimen, but the average number is less. No spores could be found while the processes were at all purple in colour, but when full-grown, they turn brown, and then spores are easily discernible at and near the apex.

Isaria belongs to the group Hyphomycetes; but the species, parasitic on insects, are mostly conidial conditions of species of *Cordyceps*.

Cordyceps belongs to the Pyrenomycetes, and is generally regarded as including the conidial states, described under the form-genus of Isaria; but until the ascigerous stage is actually found, we prefer not to class them under that genus.

Isaria Oncopteræ, McAlp. (n.sp.).

Growing from various parts of the body, dirty brown root colour, averaging $\frac{3}{4}$ to $1\frac{1}{2}$ inches high.

Stem branched, velvty, slender, tips of branches fertile. Conidia spindle-shaped to oval, hyaline, 12 μ. x 6 μ. borne on tips of hyphæ at right angles to the stroma.

On dead larvæ of *Oncoptera intricata*.

ART. XIV.—*A new Australian Stone-making Fungus.*

LACCOCEPHALUM BASILAPILOIDES, McAlp. and Tepp.

(Plate X.).

By D. MCALPINE and J. G. O. TEPPER, F.L.S.

[Read 12th July, 1894.

This species of fungus belonging to the *Polyporaceæ* does not appear referable to any of the known genera of that order. It differs from *Boletus* in the tubes of the hymenophore not being separable from the sporophore and from *Strobilomyces* in the pileus not being scaly; from central-stemmed species of *Polyporus* in the promiscuously and peculiarly pitted pileus, as well as in being always hard and woody, and from *Polystictus* by the absence of zones on the pileus. It is peculiar in forming large stony nodules at its base.

Genus LACCOCEPHALUM, McAlp.

Sporophore pileate, pitted, stem central; hymenophore inferior, consisting of closely-packed, parallel, cylindrical tubes, distinctly differentiated, but not separable, from sporophore; openings of tubes sub-rotund or oval; hymenium lining the cavities of the tubes, spores large, spherical, coloured.

This genus differs from *Polyporus*, to which it seems most nearly allied, in being hard and woody from the first, in the peculiarly pitted pileus and in the character of the spores. Name from the characteristic pitted surface of the pileus—λακκος, a pit and κεφαλη, the head.

Laccocephalum basilapiloides, McAlp. and Tepp.

Solitary. Pileus woody, irregularly concave in the middle, remainder convex (concavo-convex), $3\frac{1}{4} - 3\frac{3}{4}$ in. in dia., about $\frac{5}{8}$ in. in thickest part, brownish fawn, surface pitted, pits in the middle relatively small, conical, irregularly scattered, surrounding

rows much larger, ovate to elliptical, deepest on the inner end; circumference sub-circular, broad marginal zone smooth, undulate, not pitted promiscuously or sometimes in some parts irregularly; ridges of pits and margin of pileus coffee-colour, the latter deeper in colour because thicker; inner substance of pileus thick, whitish, unchangeable. Hymenophore greyish-fawn to reddish-brown, solid, continuous with stem; tubes adnate, averaging one line in depth, slightly contracting towards opening; pores moderately large, crowded, unequal, sub-rotund to oval; spores spherical, orange-yellow, echinulate, 44-50 in. in dia.; spines conical, acute, 3 in. long. Stem compressed oval, $\frac{1}{2} \times \frac{3}{4}$ in. in dia.; length from basal collar to hymenophore scarcely exceeding an inch, dirty fawn colour, spongy, fibrous striate, hardened like pileus, rising abruptly from an irregular, cushion-like collar of solid whitish mycelium, crowning a large, irregularly sub-conical basal part 3 in. in height; base sub-oval, $3\frac{1}{4} \times 4$ in. in dia.

The specific name has reference to this basal stone-like portion. This basal portion resembles a concretion of ferruginous sandstone in appearance and almost in density (the weight of the whole, fungus and all, $13\frac{1}{4}$ oz.) being apparently composed of the firmly agglutinated grains of the sandy soil in which it was formed, and thus fixed by the mycelium.

The upper surface is studded in many places by pappilate protuberances, and shows in the figured specimen also fragments of roots and the vestiges of an ant tunnel. The underside is only slightly convex, the abraided surface allowing the threads of the profuse mycelium to be detected; it appears similarly to other specimens, to be much less impregnated internally by ferruginous matter than externally. The figured specimen described above was obtained through Mr. A. Molineux, F.L.S. (Secretary of the S. A. Agricultural Bureau), from the south-eastern border of S. Australia, and reported as having been found in typical mallee scrub. The mycelium forms the large permanent stony base, and apparently induces the oxide of iron contained in the soil to bind the mass (from the surface inwardly into a solid nodule. Such stony nodules have been brought to the notice of one of us (Mr. Tepper) on various occasions, by persons meeting them in clearing arenaceous mallee lands. One of an almost regularly oval-shape was obtained near Ardrossan, in Yorke's Peninsula,

some twelve years ago, and subsequently exhibited at a meeting of the Royal Society, S.A. Two other nodules in his possession almost perfectly resemble tubers of potatoes, and were sent by Mr. J. G. Neuman, from Murray Bridge, in 1890, with the information that similar specimens of various sizes were often met with among the roots of tufts of sedges, etc., such as *Lepidosperma*, Herotes and Cladium in sandy soil. Both the latter are muddy-brown outside, and sandy-grey internally, quite hard and stony, but not as heavy as real sandstone. It will be noted that the upper end shows plainly the area of attachment of the stem and collar. These stone-like nodules have not been hitherto associated with fungi. The well-known Fungus stone *(Pietra Funghaia)*, which is used in Italy for the propagation of *Polyporus tuberaster*, is simply a ball of earth or sort of tufa matted together by mycelium, the dense masses of which have the property of compactly binding together the loose particles of earth. A Queensland Polyporus *(P. tumulosus, Cooke)*, has also a somewhat similar property. "On the hard stony ridges about Brisbane, when trenching the land large masses of mycelium are often met with. Some of the masses would weigh over a hundredweight. From its consistency one might fancy that a quantity of dough had been buried."* Like other Australian mysteries, such as that of the so-called Native Bread, the origin of the stony nodules is now solved by means of the described and figured specimen, and the geologist of the future may yet have to turn to fungi for an explanation of some of the puzzling concretionary forms occasionally met with.

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* Cooke Grevillea, xvii., p. 55, 1889.

Art. XV.—*Cremation and Burial in relation to Death Certification.*

By H. K. Rusden.

[Read 9th August, 1894.]

It has been alleged that the success of an occasional exhumation and autopsy in the detection of poisoning, constitutes an argument against cremation, and I consider it important that the fallacy of that statement should be thoroughly exposed. Such cases, otherwise, have the unfortunate effect of producing an impression that while such resources exist, there is ample security against poisoning, which is very far from being the case; and that impression operates simply as a delusion and a snare. For it is entirely overlooked that such expedients are but clumsy and inadequate attempts to atone for previous neglect. When delayed for but a limited period they fail to detect all but practically three metallic poisons—arsenic, antimony, and mercury; as the numerous vegetable poisons soon disappear; and, in any case, a deferred autopsy is a disgusting and defective resource. No one but an utterly ignorant person would use arsenic, as it is known to remain for years. But prevention is always far better than cure, and a sufficient examination should always be made *before decomposition and burial.* Not only would the majority of poisons disappear by delay, but it is obviously quite possible that the body itself might be removed after burial, and examination be so prevented.

Cremation as practised in Europe, and proposed here, involves far less risk of impunity for poisoners, than exists under the present system of burial. At Milan, for instance, the parents of a deceased child had obtained all the certificates required for its burial, before it occurred to them to have it cremated. The stricter examinations, however, required for cremation, demonstrated the fact that the child had been poisoned, accidentally, by sweetmeats containing copper. This significant fact not only proved the superiority of the checks used in cremation, but it

also forcibly illustrates the statement made by Judge Williams, on the 30th November, 1893, in the Melbourne Athenæum, that "*scores of people are poisoned and laid in the ground, and the crimes are never detected.*" The same opinion is held by many persons, whose opportunities for judging are above the average. The evidence given last year before the committee appointed by the House of Commons, to enquire into the lax system of death certification, directly corroborates the judge's statement, as any one may see in the *British Medical Journal* for April, May and June, 1893. It was proved that medical certificates of the cause of death were commonly given for 2s. 6d. each, upon the statement of an alleged witness of the death, but without the certifier seeing the corpse; and, that the supposed deceased was alive and well, though the insurance upon his or her life had been paid! It was also stated that some practitioners used printed forms of their own, coloured and printed in simulation of the death certificate forms issued gratuitously by the Registrar-General, but omitting the clause stating that the certifier had attended the deceased in his last illness! The consequent frauds upon Insurance Companies were neither few nor infrequent. From fifteen to twenty thousand persons are buried yearly in England without any medical certificate or enquiry.

In Victoria, a confiding public believes that a medical certificate of the cause of death is given in every case, and that the resulting security to human life is ample, notwithstanding Judge Williams' startling statement. But it is a fact, however incredible it may seem, that there is here *no statutory provision for such a certificate at all;* and, although, death certificates are received by Registrars (for merely statistical purposes only), yet, for the security of human life, they are worthless! When there is a medical attendant, the certificate is generally signed by him; when there is no medical attendant, the certificate is accepted from any person attending or present at the death, or the occupier of the house in which it occurred, or a clergyman. But it is entirely overlooked when accepting (as indispensable for statistical purposes) the certificate of the medical attendant, that as his conduct in that capacity is always liable to be called in question, his own guarantee of it can be worth no more than that of any accountant of the correctness of his own accounts, when

called in question; that is—*nil!* It is absolutely worthless for all practical purposes; yet a medical attendant's certificate is, as a rule, accepted—alone—as the best possible!

Ordinary medical certificates of the cause of death are worthless, on the ground also of *indefiniteness.* Of what worth in such a document (for any purpose) is such a word—for instance—as "enteritis," which is commonly used, and which would cover—I learn from an expert—ninety-nine cases in a hundred of poisoning, accidental or deliberate! For these reasons the present system simply offers a premium to murder.

It may be asked—Is it really necessary to have an expensive autopsy in every case of death? By no means. Sir H. Thompson, in his "Modern Cremation," has carefully estimated the percentage of cases in which there is room for doubt as to the cause of death—at one in a hundred. One autopsy in every hundred cases would not be too much to pay for, for the security all round, attained; and would in any case be trifling, compared to one exhumation and more difficult autopsy afterwards.

But the common ignorant objection to an autopsy, arises here for consideration. An antipathy, if harmless, may be defensible. But society has only itself to rely upon; and has an admitted interest, right, and duty, in claiming an autopsy for the general security against poison, etc., for the protection of human life; and what is more—in suspecting an objector of having a motive which itself should constitute an ample ground for insisting upon an autopsy. Such a suspicion should at once over-rule the objection of any person, if it failed to prevent him from making it.

Few people are prepared to believe how absolutely unprotected we are against murder; but Judge Williams' statement is no exaggeration. There is at present no guarantee that any one of us may not be poisoned and buried next week, without any enquiry whatever; provided that a registered practitioner, drunk or sober, wise or foolish, give a true but vague certificate of the cause of death—as "enteritis," after poisoning a patient—accidentally or deliberately! People forget that by insuring their lives, or making their wills, they give to others a *direct interest in their deaths*, and that there are plenty of unsuspected unscrupulous persons going about, to take advantage of the facilities afforded. Any invalid or feeble person is absolutely at their mercy, or

rather in their power. He can at present best protect himself by carefully providing for a particular examination of his corpse *before* burial, even if he suspect nothing. Let those concerned look to it.

The dismissal on Black Wednesday, in 1878, of all the country coroners, who have never been replaced, must have materially increased these risks to the provincial pouplation.

The precautions which Cremationists recommend, and for their own protection, take, make cremation far safer now than burial, as I think I have shown; for burial, under the present lax and absurd system, offers—I repeat, a premium to murder; and if the apathy of the people may be excused by ignorance or thoughtlessness, the neglect of those to whom they entrust such matters seems the more culpable.

The Cremation Committee of the Royal Society of Victoria strongly recommended that no system (of disposing of the dead) be tolerated, which does not provide amply strict examinations to obviate the possibility of such facts passing undetected.

Art. XVI.—*An Attempt to Estimate the Population of Melbourne at the present time.*

By James Jamieson, M.D.

[Read 13th September, 1894.]

In a new country like Victoria changes in the population are rapid, not merely in the total number, but also in respect of its constitution as regards age and sex. It is unfortunate that the census is taken only at such long intervals as ten years, since changes, which can hardly be estimated correctly, may have taken place long before that period has elapsed. The Government Statist, making the best use of data at his disposal, publishes monthly statements of the vital statistics of Melbourne and suburbs, and quarterly estimates of the population of the whole colony. But, as he admits, his estimates are only probabilities; because, though the number of births and deaths is matter of actual record, and must be almost exact, the arrivals and departures, by sea and across the border, cannot be known with like exactness. At one time, therefore, the increase of population may easily be greater, and at another less than is supposed. And if the totals for the whole colony are thus rather uncertain, still more must there be liability to doubt about changes in the distribution of the population in particular localities, unless some careful local census is taken at short intervals. It is obvious to anyone who travels about the city and its suburbs that there has been a large reduction in the population of Melbourne during the last two years at least. Mr. Hayter's calculation is that while, at the census in April, 1891, the number was 490,896, it had fallen, on 31st December, 1893, to 444,832, a decrease of no fewer than 46,064 persons in two and three-quarter years. In arriving at his estimate for the later date, Mr. Hayter has to depend on figures supplied by the municipal authorities in the various districts. These figures again are not arrived at on any uniform system. In some there is an actual rough census, taken by the officials when making valuations or collecting rates; and in others the calculation is based on the number of premises, known or assumed to be unoccupied, allowance being made for the average number of persons to each house, as ascertained at the

last census. These returns from the municipalities date back to about September last, the figures being adjusted in the Government Statist's office, and brought up to the end of the year.

That the figures thus obtained are liable to considerable uncertainty must, I think, be admitted. It may be interesting, therefore, at a time when the country is taking stock of its resources, to test the correctness of these estimates by an altogether independent method.

The birth rate in any community is a tolerably fixed quantity. Taking the three years, 1890-92, as an example, it appears that in Victoria the birth rate averaged 33·24 per 1000, with extremes of 33·60, and 32·54. The rate does vary, of course, but only to a slight extent within any short period. The probability, therefore, is, that if the rate seems to vary greatly, within a very short period, there is some error in the figures used, the most likely source of error being in the population figure, the number of births, being matter of almost exact record. It is this test of the birth rate, or, rather, the variation in the births recorded, which I propose to apply for arriving at an estimate of the population of Melbourne in the present year. For this purpose I will take the first half of several successive years for comparison.

TABLE I.

Showing the Number of Births Registered in Melbourne and Suburbs for 1890-94.

	1890.	1891.	1892.	1893.	1894.
January -	1251	1316	1429	1288	1123
February -	1480	1259	1443	1227	1057
March - -	1540	1338	1649	1353	1259
April - -	1478	1648	1297	1273	1123
May - -	1612	1641	1657	1369	1251
June - -	1675	1628	1470	1411	1142
	8957	8830	8945	7921	6955

The census population, at 5th April, 1891, can be taken as providing a correct birth rate for the first half of that year, viz., 17·987 per 1000. Taking that rate as a standard, and applying it to 1894, we can proceed to calculate back to the population which would provide the number of births recorded, viz., 6955. The figure of population thus brought out is 386,668. It is of course a mere assumption that the birth rate of 1894 was the same as that of 1891, and it cannot be claimed for these figures, therefore, that they are free from error. The question remains then whether their correctness can be submitted to test.

The death rate is, on the whole, a more variable quantity, from year to year, than that of births, and if it cannot therefore be so safely used for purposes of comparison, it may still be applied as a check in a similar way.

TABLE II.

Showing the number of Deaths Registered in Melbourne and Suburbs for 1890-94.

	1890.	1891.	1892.	1893.	1894.
January -	998	874	776	702	718
February -	878	733	698	665	599
March - -	995	792	862	696	623
April - -	973	749	645	632	530
May - -	797	654	607	518	537
June - -	651	649	614	631	493
	5294	4451	4202	3844	3500

Taking again the year 1891, as that for which we have exact figures, it appears that the death rate for the first half of that year was 9·06 per 1000. And using that rate as our basis it results, that the population needed to produce the number of deaths in the first half of 1894, viz., 3500, was 386,313. As this figure is almost identical with that arrived at on the basis of the

birth rate, it is fair to assume that the actual population in the first half of the present year, approached nearly to that which has now been calculated out.

It might be supposed that it would have been a safer procedure to take the three years, 1890-92, as the basis of calculation as supplying greater probability of a fair average. I do not think, however, that this is actually the case. It would be necessary to assume that the population of 1891 was the proper average of the three years, and almost certainly this was not the case. For though the population doubtless increased from 1890 to 1891, there can be as little doubt that, instead of increasing further, it had already began to fall off in 1892. This would introduce an element of error into any calculation of either birth or death rate for the three years. And, in the case of the death rate, there would be another source of error, in the fact that 1890 was a year with an exceptionally high mortality, as a glance at the figures in Table II. sufficiently shows.

But though the concurrence of results, on the two modes of reckoning, is remarkable, it must be recognised that with each of them there is liability to fallacy. In times of severe depression it is quite to be expected that there should be some lowering of the birth rate, not of course very quickly produced, and mainly by the previous production of a lowered marriage rate. There has, in fact, been a large reduction in the number of marriages in Melbourne recently, from 5172, in 1890, to 4872, in 1891; 4135 in 1892; and 3635 in 1893. This reduction in the marriages doubtless came to affect, in some degree, the number of births, though a reduction of about 500 marriages annually does not go very far to account for an annual diminution of births of about 2000 in 1893 as compared with 1892; and of as many more, to all appearance, in 1894.

As was already said, there is even greater liability to fallacy in using the death rate as a basis of calculation. And it has to be admitted that the public health was, on the whole, better in the first half of the present year than in the earlier years of the decade. It has been remarked in England that times of trade depression are commonly enough associated with a low rate of mortality. In fact, depression in England or in Australia is hardly such as to be a cause of disease or death to appreciable

extent, as it shows itself to be in countries such as India, where depression becomes actual famine. It is doubtful, indeed, whether depression, such as we suffer from, has any very direct influence on the public health. It is chiefly the degree of prevalence of epidemic diseases which causes variations of the death rate, and some of these were more largely prevalent in 1890-92 than in the present year. A mere reduction of the number of births, too, has a distinct effect in lessening the death rate, the mortality among young infants being eight or nine times greater than it is among the population as a whole. I do not wish to load this paper with figures not strictly relevant to the main issue, and will therefore content myself with these hints, and admit that the death rate probably was lower in the first half of 1894, than in 1891. That calculations, based on the number of deaths in that year are thus to some extent vitiated, may also be admitted. But that the population of Melbourne has been largely reduced in the present year, in addition to any previous losses cannot be doubted. To get as small a number of births and deaths as are now recorded we have to go back to 1886, when the population, according to Mr. Hayter's estimate, amounted only to 371,630. It does not, therefore, seem to be an extravagant statement, that the population of Melbourne and suburbs, at the present time, cannot greatly exceed the 386,000, which has, by calculation, been arrived at.

But many persons will be found to say that a lessening of population in the metropolis is not a thing to be greatly lamented, if there has been a mere transfer to other parts of the colony. A comparison of the births and deaths in the first half of successive years, in Melbourne and suburbs on the one hand, and in all the rest of the colony on the other, will help to show whether or not this has been the case.

TABLE III.

Showing Births and Deaths in first half of years 1890-94 in Melbourne and rest of Colony separately, and in Victoria as a whole.

BIRTHS.

	1890.	1891.	1892.	1893.	1894.
Melbourne -	8,957	8,830	8,945	7,921	6,955
Rest of Colony	9,609	9,771	9,856	10,386	9,987
All Victoria -	18,566	18,601	18,801	18,307	16,942

DEATHS.

	1890.	1891.	1892.	1893.	1894.
Melbourne -	5,294	4,451	4,202	3,844	3,500
Rest of Colony	4,936	4,191	4,533	4,316	4,493
All Victoria -	10,230	8,642	8,735	8,160	7,993

Certainly these figures show that there has been a marked difference of conditions prevailing in the metropolitan and extra-metropolitan portions of the colony. We are entitled to infer that there has been, at least, no loss of population in the latter portion, since 1891. And if there actually has been a lower than average birth and death rate in the one portion, the same has doubtless been true of the other. In that case, what looks like fixity of population may really indicate some increase. According to Mr. Hayter's estimate, the population of extra-metropolitan Victoria, on 31st December, 1893, was 729,174; while it was only 649,509 at the census in April, 1891. It would be a satisfaction to be able to believe that there was an increase of almost 80,000 persons in the two and three-quarter years; but, in

the face of the figures given in Table III., it is hardly possible to accept the estimate as a correct one. The explanation, doubtless, is that the unrecorded departures have been considerably more numerous than the official figures show. Considering the trials which Victoria has lately undergone, it is fair matter of congratulation, if her population, at the present time, is not less than it was in 1891.

ART. XVII.—*The Older Tertiaries of Maude, with an Indication of the Sequence of the Eocene Rocks of Victoria.*

By T. SERGEANT HALL, M.A. (Assistant Lecturer and Demonstrator in Biology in Melbourne University),

and

G. B. PRITCHARD (Lecturer in Geology, Workingmen's College, Melbourne).

[Read 13th September, 1894].

The sections of the tertiary rocks displayed in the valley of the Moorabool River, near Maude and to the northward, were early recognised as throwing considerable light on the correlation of beds which are separately better developed elsewhere. In 1866 Sir Alfred R. C. Selwyn reported to Parliament* on the age of the Victorian gold drifts, and the report was, in the following year, reprinted by him with reduced copies of the sections therein contained in the Exhibition Essays.†

On the evidence there detailed, the older volcanic rocks, the plant beds underlying them and certain non-auriferous gravels occurring in the neighbourhood of Maude, and elsewhere in the colony, were referred to the miocene of the survey, that is to our eocene. Mr. C. S. Wilkinson, assisted by Mr. R. A. F. Murray, made a minute geological survey of a part of the district, and the quarter-sheet (19 S.W.) which includes the most important part of the area, was published in 1865. Unfortunately the sheet of sections and explanatory notes, which should have accompanied the map, has never appeared. The results of our observations on the eocene bed at Curlewis‡, rendered it advisable that an early visit should be paid to the Maude district, and a recent vacation has afforded us the desired opportunity.

* Votes and Proceedings of the Legislative Assembly of Victoria, 2nd Session, 1866, vol. i.

† Exhibition Essays, 1866-67, pp. 21-26.

‡ Proc. Roy. Soc. Vic., 1893, p. 18.

The eocene rocks occupy an area of slightly elevated ground flanking the ordovician rocks which extend south from Steiglitz. To the east, south, and west, the country is covered by an almost unbroken sheet of what is generally called the "Newer Volcanic Rock." The surface of the exposed eocene rises slightly above the level of the basaltic plain, and the geological boundary is marked on the west by the valley of the Moorabool River, and on the east by that of Sutherland's Creek, the two streams meeting a little to the south of the area. The eocene beds underlie the basaltic plains and are exposed wherever the streams have cut through the overlying rock, which extends from Port Phillip to beyond Hamilton in the west. The valleys of the two streams above alluded to are very striking features in the district. Aneroid measurements showed their depth to be about 250 feet in each case, and the Moorabool Valley averages about a mile in width, while that of Sutherland's Creek is slightly narrower. It is in the sections displayed along these steep sided valleys that the geology of the district can best be studied.

The bed rock of the immediate neighbourhood is ordovician, but granite outcrops frequently between the Anakie Hills and the Dog Rocks, near Geelong, both of which are composed of this rock. Aided by the quarter-sheet, we examined all the marine eocene outcrops we could find, and a description of the more instructive sections will make the structure of the district clearer.

On the Moorabool, a section line is indicated on the map crossing the valley, and passing through an outcrop of limestone underlying the older volcanic rock. This line we examined carefully. The surface soil on the east of the valley is very sandy, so that there is at first a very gradual descent towards the stream. The section is approximately as follows :—

EOCENE—	
Sandstone passing down into limestone	? 40 feet.
Limestone	10 ,,
Older volcanic	120 ,,
Sandy limestone and conglomerate ...	30 ,,
ORDOVICIAN—	
Slates and sandstones	40 ,,
	240 feet.

The sandstone capping the hill covers the whole of the area between the two streams, excepting in one or two places where an outlier of newer volcanic rock overlies it, or where minor valleys have cut through it. It gradually passes down into limestone which is in places largely composed of polyzoa and echini spines. The base of the limestone rests on the surface of the basalt, which, though approximately level when taken as a whole, is carved into steep and irregular depressions. The lower part of the limestone is full of well rounded basalt fragments, from mere pebbles up to blocks of great size. Close to the junction, and extending up from it for a variable distance in the different sections, the limestone is altered to a hard pink crystalline rock, which is described by Professor Sir F. McCoy as in some places "closely resembling lithographic stone."*

This rock is full of fossils, but for the most part they exist as casts only. They consist of trochiform shells, haliotis, cerithium, and such forms as to-day live on the rocky, bouldery parts of our coasts. That the Maude fossils are littoral forms has been pointed out by Sir Fredk. McCoy.† The talus blocks of this hard limestone are thickly strewn over the slopes below the outcrop, and dozens of specimens, picked up at random and broken with the hammer, displayed, in nearly every instance, rounded fragments of basalt embedded in the mass. In no single section did we find any evidence of the intercalation of a thin sheet of basalt. We inspected every outcrop we could find, and they were many, and followed the valley some distance south of the boundary of the quarter-sheet into unmapped country, but could find no sign of the basalt which is represented on the map as overlying the limestone, and as being in its turn overlain by other "miocene" (eocene) beds. The numerous small quarries for limestone showed over and over again, rounded pebbles and blocks of basalt scattered through the rock. As we go up from the basalt we find the limestone becoming less and less altered, till it assumes the character of the ordinary polyzoal rock, that is a rock of which the well-known Waurn Ponds building-stone may be taken as the lithological type. In this comparatively unaltered rock basalt fragments occur, but are not as numerous

* Prod. Pal. Vic., Dec. III., p. 24. † *Id.* p. 23.

as in the lower portion, and are often associated with small quartz pebbles. In a section displayed on the roadside between the State School and the old mill, at The Clyde, we measured one embedded basalt block exposed, and found it ten feet long and four feet thick. Another boulder was five feet by three feet six inches; and these great masses were associated with numerous fragments of all sizes, down to small pebbles; and all were well rounded. Packed in between the boulders was a deposit of comminuted polyzoa, broken and worn spines of echini, fragments of brachiopod shells and of pectens, but perfect specimens of any kind were rare.

It may be that the officers of the survey felt the necessity of accounting for the alteration of the rock to a crystalline limestone by igneous action, and were led to attribute it to an intercalated flow, taking the large included blocks as portions of such a sheet. The subsequently opened sections, however, dispose entirely of such an interpretation. On the opposite side of the river from this Clyde section, a large quarry is a conspicuous object on the hillside. This shows a clean face of nearly thirty feet, and is about fifty yards in length. The limestone, which forms the greater part of the quarry floor, rests on a very uneven basaltic surface, and extends about ten feet up the face. It is distinctly less altered as we go up from the volcanic rock, and is capped by arenaceous and calcareous beds, which reach apparently to the top of the hill. The cause of the change in character has, then, evidently acted from below, and is not due to a more recent flow of basalt. What this cause may have been is not clear to us, but we have recorded a similar alteration in the polyzoal rock overlying the ash beds of Curlewis.* Mr. D. Avery, M.Sc., has kindly examined the rock for us, and says there is only a very small amount of magnesia present, so that the changed character has not been brought about by dolomitisation.

Wherever the limestone is unaltered it is seen to be, both lithologically and palæontologically, the equivalent of that of Waurn Ponds.

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* Proc. Roy. Soc. Vic., 1893, p. 3.

COMPARATIVE TABLE BETWEEN UPPER MAUDE BEDS, AND WAURN PONDS.

Name of Specimen.	Upper Maude Beds.	Waurn Ponds.
ZOANTHARIA.		
Placotrochus elongatus, Duncan	-	X
Notocyathus australis, Duncan	X	-
Balanophyllia australiense, Duncan	X	-
Graphularia senescens, Tate	-	X
Isis, 2 spp.	-	X
ECHINODERMATA.		
Echinobrissus vincentianus, Tate	X	-
Echinobrissus australiæ, Duncan	-	X
Echinobrissus n. sp. ?	-	X
Paradoxechinus novus, Laube	X	-
Echinolampas posterocrassus, Gregory	†X	X
Psammechinus Woodsii, Laube	†X	X
Scutellina patella, Tate	†X	X
Schizaster abductus, Tate	‡X	-
Toxobrissus sp.	X	X
Pericosmus Nelsoni, McCoy	-	X
Eupatagus murrayanus	-	X
Holaster australis, Duncan	-	X
Cyclaster archeri, T. Woods	-	X
Cidaroid plates and spines	X	X
CRUSTACEA.		
? Balanus sp.	X	X
Crab remains	X	-
POLYZOA	Abundant	Abundant
PALLIOBRANCHIATA.		
Waldheimia furcata, Tate	X	X
Waldheimia grandis, T. Woods	X	X
Waldheimia insolita, T. Woods	-	X
Waldheimia tateana, T Woods	X	-
Waldheimia corioensis, McCoy	-	X
Waldheimia garibaldiana, Davidson	-	X
Terebratula vitreoides, T. Woods	-	X
Rhynchonella squamosa, Hutton	X	X
Terebratulina scoulari, Tate	X	X
Magasella compta, G. B. Sowerby	X	X
Crania quadrangularis, Tate	X	X
Terebratella n.sp. aff. pentagonalis	X	-
Terebratella (?) sp. nov.	X	-
LAMELLIBRANCHIATA.		
Ostrea sp.	X	X
Placunanomia ione, Gray	-	X
Dimya dissimilis, Tate	X	X
Pecten foulcheri, T. Woods	X	X
Pecten murrayanus, Tate	-	X
Pecten polymorphoides, Zittel	X	-

Name of Specimens.	Upper Maude Beds.	Waurn Ponds.
Pecten yahlensis, T. Woods - - -	-	X
var. semilævis, McCoy		
Pecten subbifrons, Tate - - -	-	X
Pecten gambierensis, T. Woods - -	-	X
Pecten n.sp. aff., Eyrei - - -	-	X
Lima Bassii, T. Woods - - -	X	-
Limatula Jeffreysiana, Tate - - -	X	-
Limatula crebresquamata, Tate M.S. -	-	X
Spondylus pseudoradula, McCoy - -	X	X
Lucina n. sp. - - - - -	X	-
Gastropoda.		
Triton tortirostris, Tate - - -	X	-
Triton n.sp. - - - - -	X	-
Voluta sp. (pullus) - - - -	X	-
Ancillaria pseudaustralis, Tate - -	X	-
Drilla 3. spp. - - - - -	X	-
Conus heterospira, Tate - - -	X	-
Cypræa spp. (casts) - - - -	X	X
Cypræa sp. (cast of a very large species, probably *C. gigas*) - - -	X	X
Natica Mooraboolensis, Tate - - -	X‡	-
Thylacodes conohelix, T. Woods - -	X	X
Thylacodes n.sp. - - - - -	X	-
Niso psila, T. Woods - - - -	X	-
Cerithium Flemingtonensis, McCoy - -	X	-
Cerithium sp. - - - - -	X	-
Triforis, sp. - - - - -	X	-
Liotia sp. aff. Roblini - - - -	X	-
Tinostoma n.sp. - - - -	X	-
Turbo ? n.sp. - - - - -	X	-
Opercula of Trochoid shells - - -	X	-
Pleurotomaria tertiaria, McCoy - -	X§	-
Haliotis Mooraboolensis, McCoy - -	X§	-
Haliotis ovinoides, McCoy - - -	X§	-
Scutus anatinus, Donovan - - -	X‡	-
Pisces.		
Carcharodon megalodon, Agassiz. - -	-	X
Carcharodon angustifrons, Agassiz. - -	-	X
Lamna sp. - - - - -	-	X
Oxyrhina sp. - - - - -	X	X
Palate aff. Diodon. - - - -	-	X
Mammalia.		
Ziphius (Dolichodon) Geelongensis, McCoy -	-	X§
Squalodon Wilkinsoni, McCoy - -	-	X§
Cetotolites Leggei, McCoy - - -	-	X§
Cetotolites Nelsoni, McCoy - - -	-	X§
Cetotolites Pricei, McCoy - - -	-	X§

Note.—Those marked § have been recorded by Sir F. McCoy, and ‡ by Professor Ralph Tate, and those marked † have been shown us by the Rev. A. W. Cresswell, M.A., who informs us he collected them from the locality indicated.

SUMMARY.

——	Upper Maude Beds.	Waurn Ponds.
Zoantharia - -	2	4
Echinodermata - -	8	11
Crustacea - - -	2	1
Palliobranchiata - -	9	10
Lamellibranchiata -	8	11
Gastropoda - -	26	3
Pisces - - -	1	5
Mammalia - -	—	5
Total - -	56	50

An inspection of the list of fossils from the Upper Maude Beds, and from Waurn Ponds, brings out the close relationship existing between them. The most noticeable difference is caused by the presence of gastropods in the former beds, but it should be noted, that nearly the whole of these were obtained from the section above mentioned, near the Clyde, on the east bank of the river, and from a deposit overlying the polyzoal rock. This overlying deposit really represents the clays occurring at the Filter Quarries, at Batesford*, where the majority of these gastropod species are well represented. The deposit is of a very peculiar nature, and at first sight looks like a sandy clay full of brown pisolitic ironstone pebbles. A closer inspection and the use of the acid bottle, show that it is really a calcareous clay, and that the supposed ironstone pebbles are nearly all recognisable as casts of fossils. Some of these preserve the external form, while others are merely internal casts. Gastropods, echinus spines and polyzoa are all found thus preserved, and the ornamentation of the mollusca is frequently well-shown. All the casts are highly glazed, and of a dark brown colour. They are easily separable

* See below, p. 193.

from the matrix, and are readily crushed between the fingers. It is then found that the ferruginous coat is very thin, and surrounds an earthy internal part of a light fawn colour, similar to the matrix in which the casts are embedded. We have not seen anything comparable to this method of fossilisation, and are at a loss for an explanation of the processes which have brought it about.

The older volcanic rock in the district is much decomposed, and towards its upper part is full of amygdules of carbonate of lime, while some lumps of radiating crystals of arragonite, about half-a-pound in weight, were found on the slopes. The soil produced from the decomposition of the basalt is very fertile, and the valley was formerly noted for its vineyards, which have, however, now entirely disappeared, having been uprooted when *phylloxera* was prevalent in the district some years ago.

Below the older basalt in the first section indicated, we find, as shown on the map, another outcrop of limestone, which is very variable in its composition. As a rule, it is arenaceous and earthy, and is in places full of casts while actual fossils are scarce. When they were obtained they were so encrusted with a strongly adhering calcareous coat that while we were gathering them we were rarely able to recognise them specifically, and were consequently quite in the dark as to the equivalence of the beds, especially as one of the commonest forms was a new species of *Trigonia*. There can however be no doubt, as an examination of the faunal list will show, that the limestone represents the lower portion of the Spring Creek section. As we approach the base of the limestone, fragments of slate and quartz make their appearance, and gradually become more abundant, till at length we find the limestone has disappeared, and a conglomerate of well-rounded pebbles has taken its place. In the limestone and conglomerate basalt pebbles are conspicuous by their absence, although we spent some time in a careful search for them. This fact, together with the considerable extent of the outcrop, its evident bedding, and the great change in fauna, precludes the idea of its being a talus. We did not, it is true, see the actual junction of limestone and overlying basalt; but, unhesitatingly, agree with the interpretation of Messrs. Selwyn, Wilkinson and Murray as regards their relationship.

This section then settles the age of the older volcanic rock. It is eocene. In a paper, read by ourselves, on 9th March of

last year* we stated that it would seem advisable to refer the older volcanic rock to two distinct periods, should it be found that it was anywhere intercalated with eocene rocks, as we showed that it was in some cases overlain by beds which had been referred to lower eocene. At a later date† we suggested that it might be found advisable to remove it altogether from the tertiary period. Messrs. Tate and Dennant, subsequently to our first paper,‡ stated that the older volcanic rock "may ultimately prove to be cretaceous;" while Professor Tate, in the tabular view of the Tertiary Strata of Australia, as given in his Presidential Address before the Adelaide Meeting of the Australasian Association, puts the older volcanic rock under the head of pre-eocene, while, by a strange oversight, the leaf beds underlying it are referred to the eocene period. There is, we now think, not sufficient evidence to suggest a subdivision of the volcanic rock, and certainly none for considering its age anything but eocene.

Fossils from Lower Beds at Maude.

Zoantharia.

Placotrochus elongatus, Duncan.
Notocyathus australis, Duncan.
Bathyactis discus, T. Woods.

Echinodermata.

Maretia anomala, Duncan.
Monostychia sp.
Fibularia gregata, Tate.
Fibularia n.sp. (?)
Scutellina patella, Tate.

Annelida.

Serpula sp.

Polyzoa.

Well represented.

Palliobranchiata.

Magasella compta, G. B. Sowerby.
Terebratulina Scoulari, Tate.
Rhynchonella squamosa, Hutton.
Crania sp.

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* Proc. Roy. Soc. Vic., 1893, p. 1.

† Proc. Austr. Ass. Adv. Sci., Adelaide Meeting, p. 342.

‡ Proc. Roy. Soc. S. Aust., 1893, p. 212. Read 2nd May, 1893.

Lamellibranchiata.

Ostrea sp.
Dimya dissimilis, Tate.
Pecten consobrinus, Tate, var.
Pecten Foulcheri, T. Woods.
Limopsis insolita, G. B. Sowerby.
Limopsis Belcheri, Adams and Reeve.
Pectunculus Cainozoicus, T. Woods.
Cucullæa Corioensis, McCoy.
Trigonia n.sp. aff. semiundulata.
Cardita n.sp.
Lucina leucomomorpha, Tate.
Dosinia Johnstoni, Tate.
Myadora tenuilirata, Tate.
Corbula pyxidata, Tate.

Gastropoda.

Turritella conspicabilis, Tate.
Mathilda transenna, T. Woods.
Rissoina sp.
Tinostoma sp.
Solariella sp.
Cylichna exigua, T. Woods.

Scaphopoda.

Entalis subfissura, Tate.

Pisces.

Otoliths.

SUMMARY.

Zoantharia	3
Echinodermata	5
Annelida	1
Palliobranchiata	4
Lamellibranchiata	14
Gastropoda	6
Scaphopoda	1
Pisces	1
	35

In the mollusca proper of the above list there are only three which have not hitherto been recorded from Spring Creek, namely, one lamellibranch which is a new trigonia, the diagnostic characters of which will be published shortly, and two gastropods. With regard to the representatives of the other classes, the majority also occur at Spring Creek, or in beds belonging to an equally low horizon in the tertiary series. This obviously shows the close relationship existing between the Lower Maude and Spring Creek beds. Upon stratigraphical grounds the Lower Maude beds are evidently very low down in the tertiary series. Our previous work in the Geelong district had led us to suspect that this was also the case at Spring Creek.

If we look at the results to be obtained from a critical examination of the Spring Creek fossils we have satisfactory confirmation of the above.

Messrs. Tate and Dennant, in their correlation paper,* record 227 species of mollusca, of these we are only able to pick out three living species which gives *a percentage of 1.3*. One of the above living species, namely, *Nucula Grayi, D'Orbigny* [= *Nucula tumida, T. Woods*] is, however, not recognised as such by Professor Tate This identification has been made on a careful comparison of the living shells, dredged in Port Phillip Bay, with our fossil species. We have been able to add sixty-six molluscan species to the above referred to paper, making a total of 293, without increasing the number of living species, so that it seems perfectly safe for us to assert that the *percentage of living species in these beds is one*, or at most, very slightly over.

As the older basalt overlies beds of this horizon, and is overlaid unconformably by limestones of the Waurn Ponds type, and clays of the Lower Muddy Creek or Mornington type, the two latter conforming to one another with a gradual change in sediment where a junction is seen,† it will be of interest and importance to examine the results of the percentage theory as applied to the Muddy Creek beds. Messrs. Tate and Dennant, in the paper above referred to, state:—"Out of a total of 725 species of all classes from the two well-marked zones at Muddy Creek, 511 have been definitely traced to the lower beds. Of

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* Trans. Roy. Soc. S.A., 1893.

† Proc. Roy. Soc. Vic., N.S., vol. iv., p. 11.

these, from six to eight still survive, and the percentage of recent to extinct forms is thus about one and a half." In the list of fossils appended to Messrs. Tate and Dennant's paper, there are only 250 mollusca from Muddy Creek, which is obviously incomplete. Mr. Dennant, in a much earlier paper,* refers 405 species of mollusca to the lower zone. There are at least *ten recent species* now known from these beds which gives a *percentage of nearly two and a half.* It is not quite clear whether the 511 species mentioned above is intended to indicate mollusca only, but even if this should be the case, as is likely, we would still have nearly two per cent. of living species, which decidedly indicates an horizon younger than the Spring Creek beds, and is confirmatory of the stratigraphical sequence already indicated.

The section at North Belmont shows a resemblance to the Spring Creek beds in the occurence of:—*Cucullaea Corioensis, McCoy*, *Trigonia semiundulata*, *McCoy*, *Chione Pritchardi*, *Tate m.s.*, and *Chione cainozoica*, *T. Woods*, and some common forms of echinoderms and palliobranchs, and may tentatively at least be placed on the same horizon until more evidence is forthcoming.

According to Sir Alfred Selwyn,† the beds containing plant remains pass under the marine tertiaries to the north of Maude, but our stay was too short to allow us any time for examining the evidence on this point. In the sections on Sutherland's Creek, to the eastward of the first sections we mentioned, we find the ordovician rocks overlain by nearly 100 feet of quartzite and sandstones. The grain of this rock is fairly fine, and we found no trace of gravel or conglomerate in the beds. The change from loose sand into fairly compact sandstone, and then into quartzite seems very irregular. At the point where the ordovician is lost sight of as we go south, the overlying series consists of a white or brown rock on which the hammer makes but little impression, so that the alteration has been effectually carried out. In some places higher up the stream the quartzite may be traced up to the top of the deposit, whilst in others, the upper part consists of loose sand. It is not quite clear whether the beds are the equivalents of the lower limestone of the Moorabool Valley above described, or of the plant beds, though the latter seems more probable.

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* Trans. Roy. Soc. S.A., 1888, p. 39, *et seq.*

† Exhibition Essays, 1866-67, pp. 21, *et seq.*

With regard to the occurrence of a quartzite in the tertiary series, Professor J. W. Dawson, in speaking of one overlying the eocene in Egypt, uses words which exactly apply to our rock.* "The Red Mountain, near Cairo, . . . is composed of a hard brown, reddish and white sandstone . . . In many parts it has the characters of a perfect quartzite, and appears at first sight extremely unlike a member of the tertiary series . . . The induration of the beds seems to be local, and to be connected with certain fumarole-like openings, which have probably been outlets of geysers or hot siliceous springs contemporaneous with the deposition of the sand." Perhaps the same cause has been efficient at Maude. A somewhat similar tertiary quartzite, it it may be mentioned, occurs at Keilor, but is higher in the series, and is capped by newer and not by older basalt.

Overlying the quartzites of Sutherland's Creek, we have the older volcanic rock, and over this again limestone of a similar nature to that already described in the previous section. On the eastern side of the valley this is in some places capped by the newer volcanic rock. Near the most southerly outcrop of the ordovician on Sutherland's Creek we found the section to be, approximately, as follows :—

Newer volcanic	40	feet.
Sandy limestone	20	,,
Older volcanic	60	,,
Quartzite and sandstone ...	90	,,
Ordovician slate	40	,,
	250	

THE SEQUENCE OF SOME OF THE VICTORIAN EOCENE BEDS.

The recognition of the fact that the sandy limestone underlying the older basalt of Maude, is practically the equivalent of the lower part of the Spring Creek section, and that the upper beds at Maude are the representatives of those at Waurn Ponds, supplies a hint that is of use in unravelling a good deal of the stratigraphical sequence of the eocenes, and we have gathered together a few facts which show that we are now in a position to

* Geol. Mag., N.S., Dec. III., vol. i., 1884, p. 385.

do something towards a better understanding of the deposits. That there are different horizons is what we should expect to find, and though lithological and bathymetrical conditions will constantly have to be kept in view as affording some explanation of differences in the faunas of different localities, still to ascribe everything to this and to "colonies," is surely asking more than is likely to be granted. An examination of the published lists of fossils from the lower beds of Muddy Creek,* Mornington, Gellibrand, and Camperdown,† Lower Moorabool Valley (Fyansford, etc.),‡ Belmont and Curlewis,§ Bairnsdale,‖ will show that these beds are on much the same horizon, though the exact relationships are not yet definitely fixed. No lists have been published for Corio Bay, Altona Bay, Newport, or Murgheboluc, but our knowledge of the desposits enables us to refer them to the same series, as the number of fossils at present known to us from these localities is as follows:—

Corio Bay	...	...	150 species.
Altona Bay	...	...	70 ,,
Newport	...	...	115 ,,
Murgheboluc	...	...	102 ,,

From Shelford we have over one hundred and fifty species, gathered by Messrs. Donald Clark, Betheras, and Alex. Purnell, which show that this deposit also may be referred to the same group.

We have shown that the clays at Curlewis¶ overlie a polyzoal limestone similar, lithologically, to that of Maude, and the same is the case at Batesford.☙ With regard to the latter place, it may be mentioned as a further confirmation of our previous reading of the section, that the work carried on at the "Filter Quarries" has displayed a face showing the limestone capped by about ten feet of eocene clay, rich in fossils, together with a thin clay band

* Trans. Roy. Soc. S. Aust., 1888, pp. 40-52.

† *Id.*, 1893, pp. 218-26.

‡ Proc. Roy. Soc. Vic., 1891, pp. 18-26.

§ *Id.*, 1893, pp. 10-13.

‖ Proc. Roy. Soc. Vic., 1890, p. 67. For most of these localities see also "Remarks on the Tertiaries of Australia; together with Catalogue of Fossils"—South Australian School of Mines and Industries, Adelaide, 1892.

¶ Proc. Roy. Soc. Vic., 1893, p. 3.

☙ *Id.*, 1891, p. 11.

intercalated with the upper part of the limestone. This clay is remarkable, chiefly for the great preponderance of trochiform shells, but otherwise resembles the section described by us on the other side of the valley.

There is little doubt that the polyzoal limestones of Waurn Ponds, Maude, Curlewis, and Batesford, are on the same horizon, though slight differences in the faunas certainly exist.

At Flinders and at Airey's Inlet,* at Curlewis and at Maude, a polyzoal rock rests on the older basalt. This in its turn, at Maude, overlies a sandy limestone containing a fauna which is the equivalent of that of Spring Creek. At Waurn Ponds the limestone overlies a clay in which fossils have not as yet been found, but which Mr. Wm. Nelson states† to closely resemble that of Spring Creek.

The Waurn Ponds rock can be traced almost uninterruptedly from M'Cann's quarries, which is the best known exposure, as far as a quarry on the south side of the Barwon River opposite the end of Pakington Street, Geelong. The locality of this quarry we shall indicate by the name of North Belmont. The rock here is a sandy limestone, and the fauna shows a stronger relationship to that of Spring Creek on account of the greater number of mollusca which it contains; though, unfortunately, most occur merely as casts. The dip of the beds is well pronounced being E. 40° S. at 10° This would carry them below the Belmont clays shown in the oft quoted well,‡ and Mr. J. Mulder informs us that limestone was struck at the bottom of the shaft after passing through the clay beds.

The polyzoal rock then appears to be antecedent to the clays of the Lower Muddy Creek type, and to overlie beds with a fauna similar to that of Spring Creek.

It will be seen that we almost entirely reverse the sequence as interpreted by Professor Sir Fredk. McCoy, and adopted by the Geological Survey. According to this view the clays of Mornington, Southern Moorabool Valley (Fyansford, etc.), and

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* Proc. Roy. Soc. Vic., 1893, p. 18; Trans. Roy. Soc. S.A., 1893, p. 212; Krausé, First Prog. Rep. Geol. Surv. Vic., 1874, Section IV.

† Proc. Geol. Soc. Aust., vol. i., pt. i., p. 19, 1886.

‡ Proc. Roy. Soc. Vic., 1893, p. 16; and Prof. Tate, Trans. Roy. Soc. S. Aust., 1893, pp. 216, etc.

the Gellibrand River, are the the lowest members of the tertiary group occurring in Victoria, and are referable to the oligocene period, while the beds at Spring Creek are divided into upper, middle, and lower miocene. Selwyn states* that the older volcanic rock marks the close of the miocene period. These views are adopted by Mr. R. A. F. Murray in his work on the Geology of Victoria.

Professor Ralph Tate and Mr. J. Dennant in their paper on the Correlation of the Marine Tertiaries of Australia,† do not attempt any subdivision of the eocene beds, but state that by Professor McCoy the deposit at Mornington "is correctly placed at the base of the tertiary series,"‡ though, whether they intended to imply that it is the oldest of our eocene beds is not clear. Of the older basalt it is said that it may "ultimately prove to be cretaceous,"§ while more recently Professor Tate, as above indicated, refers it to pre-eocene age. Below this series of rocks we have, as shown by Selwyn,‖ at any rate one set of leaf-beds, namely those occurring below the older basalt. Whether these beds are still to be retained in the tertiary period, or are to be referred to cretaceous times is, as we have previously shown, still an open question.¶

SUMMARY.

Judging by the percentage of recent species of mollusca occurring in the various deposits, we should expect those of the Spring Creek type to underlie the clays of the Lower Muddy Creek type, and the detailed stratigraphical evidence that we have brought forward points in the same direction. We are then, on these grounds, justified in arranging the eocene rocks of Victoria, in so far as they have been critically examined, in the following order, beginning with the highest beds.

1. Clays of the Lower Muddy Creek Type.—Occurring at Muddy Creek, Mornington, Belmont, Curlewis, Lake

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* Exhibition Essays, 1866-67, p. 29.

† Trans. Roy. Soc. South Australia, 1893.

‡ *Loc. cit.*, p. 216.

§ *Loc. cit.*, p. 212.

‖ Exhibition Essays, p. 21.

¶ Aust. Ass. Adv. Science, Adelaide, 1893, p. 338.

Connewarre (Campbell's Point, etc.), Southern Moorabool Valley (Fyansford, etc.), Corio Bay, Altona Bay (bore), Newport (shaft), Gellibrand, Camperdown (Gnotuk), Murgheboluc, Shelford, Bairnsdale (Mitchell River).

2. Polyzoal Limestone of the Waurn Ponds Type.—Occuring at Waurn Ponds, Batesford, Maude, Curlewis, Flinders, ? Airey's Inlet, ? Muddy Creek.

3. Older Volcanic Rock.

4. Clays and Limestones of Spring Creek.—Maude and (?) North Belmont.

ART. XVIII.—*On a Molluscan Genus new to, and another forgotten from, Australia.*

(Plate XI.)

By C. HEDLEY, of the Australian Museum, Sydney.

(Communicated by G. B. Pritchard).

[Read 13th September, 1894].

The genus *Lucapinella* was described by Pilsbry on p. 195, of vol. xii., of the First Series of the "Manual of Conchology." He placed in it the following species,—*callomarginata*, Carpenter, the type, from California; *æqualis*, Sowerby, from the west coast of South America; *limatula*, Reeve, from the West Indies, and doubtfully, *aculeata*, Reeve, of unknown habitat.

Some Australian species, though not exactly coinciding with the definition drawn up from spirit specimens of *L. callomarginata*, still appear to me to resemble it sufficiently to justify their inclusion in this genus. My attention was first drawn to this subject by an examination of specimens, the property of the Biological Laboratory of the Melbourne University, dredged in Port Phillip by Mr. Bracebridge Wilson, and kindly communicated to me by Mr. G. B. Pritchard. While studying these I captured alive, at low water, under stones, in Long Bay, near Sydney, a half-grown mollusc, which, known to local collectors as *Fissurella nigrita*, Sowerby, and transferred by Pilsbry to his genus *Megatebennus*, proved at a glance to be generically the same as the forms received from Victoria.

Introductory to the study of the dead Victorian specimens I offer the following notes on the Long Bay animal, which I kept alive in a bottle for some days.

LUCAPINELLA NIGRITA, Sowerby.

(Figs. 1, 2).

Habits active. Foot and mantle rose, papillæ on foot and mantle white, coronal processes white, sole yellow, snout brown, tentacles

and anal tube orange, a few papillæ along the shell black. Foot, when extended, more than twice the length of the shell, bearing numerous papillæ of various sizes, a few along the epipodial furrow becoming larger and tongue-shaped. Tentacles subcylindrical, tips blunt, half as long as the shell, with conspicuous eyes placed on their outer bases. Snout half the length of the tentacles, slightly tapering, mobile, oral orifice longitudinal. Anal tube sometimes exserted a short distance, surrounded by cushion-like papillæ. Mantle roughened externally and denticulated on both margins by numerous small papillæ, outer margin free all round, capable of sheltering the retracted head and falling curtain-wise from the shell's periphery to the foot; inner margin not overlaying the shell, produced into sixteen erect, branched, waving processes which surround the shell like a crown. Viewed from above these coronal processes give the whole animal the general aspect of a sea-anemone; this, my colleague Mr. Waite, has suggested to me, may be a case of protective mimicry.

LUCAPINELLA PRITCHARDI, new species.

(Figs. 3, 4, 5, 6, 7).

From a shell collected at Flinders, Western Port, Victoria, by Mr. J. H. Gatliff, I derive figures 5 and 6, and the following description.

Shell oblong, twice as long as broad, parallel sided, ends rather abruptly rounded, slightly pinched on either side of the perforation. When standing on a plane surface the posterior end is suddenly and highly, the anterior gradually and slightly elevated; there is also a space in the middle where the edge of the shell does not stand upon the ground. Perforation narrowly oval, a quarter of the shell's length, its anterior end the shell's centre; viewed edgeways the notch is seen to be cut deepest at the hinder end. Surface sculptured by about ninety radiating unequal riblets, broader than their interstices, beaded where cut across by circumferential growth lines, near the margin this sculpture developes into imbricating scales upon the riblets. Colour—pink, obscurely rayed by half a dozen yellow segments. The interior is white, smooth and porcelainous, except at the sharp edge where it is pink and crenelated by the external

riblets; posteriorly the edge is bordered within by a heavy callus, which gradually thins out about the middle of each side; the perforation is also surrounded by a callus. Length 24, breath 12, height 5 mm.

Another and larger specimen from Aldinga Bay is 27 mm. long, and 13 broad.

Of the spirit specimens from Port Philip represented by figures 3 and 4 I observe that the coronal processes number 20, the exposed portion of the tail nearly equals the shell in length, is closely covered with simple and compound tubercles, and deeply, transversely wrinkled; epipodial groove indistinct, but marked by a line of large conical papillæ. From the original of fig. 4, I extracted a radula, fig. 7, composed of a small triangular rachidian, two sloping chisel-shaped laterals, a large outer lateral, whose cusp is shaped like a scythe blade, and armed with an inner tubercle, and two rows of pin shaped uncini.

Habitat.—Flinders (Gatliff) and Port Philip (Wilson), Victoria. Aldinga Bay, St. Vincent's Gulf, South Australia (Pritchard).

Type.—The original of Fig. 3, in the Biological Laboratory of the Melbourne University.

I have much pleasure in associating this interesting animal with the name of my friend, Mr. G. B. Pritchard.

SCYLLÆA PELAGICA, Linne.

A specimen collected by Mr. J. B. Wilson, in Port Philip, and forwarded from the Biological Laboratory of the Melbourne University, by Mr. Pritchard, accords with the figures and description of this species given by Dr. Collingwood in the Trans. Linn. Soc., Zool., Second Series, ii., pp. 137-8, pl. x., ff. 29-33. Much uncertainty envelopes the species assigned to *Scyllæa*. Bergh writes: "Several species have been described, or at least named, some of which will no doubt eventually prove to belong to one circumæquatorial species." Alder and Hancock say: "The species of this genus have been so imperfectly described that it is not easy to decide on their specific differences." To the former authority we owe the latest list of the species, Zoologischen Jahrbuchern, v., pp. 59-62.

Though apparently unknown to Australian naturalists, and omitted from all papers on Australian Mollusca, especially from

Tate's Census of the Molluscan Fauna of Australia, Trans. Roy. Soc. S.A., XI., pp. 70-81, this genus has once before been reported from Australian Seas. Cuvier, in the "Annales du Museum d'histoire naturelle" vol. vi., p. 424, states, "We may add that the companions of Baudin saw it (*i.e.*, *S. pelagica*) near the Terre d'Edels, on the south-west coast of New Holland:" Terre d'Edels was a name given to the coast of Western Australia, between Swan River and Shark Bay. It is described in Freycinet's "Voyage aux Terres Australes," pp. 169-185.

EXPLANATION OF PLATE.

Fig. 1.—Enlarged outline sketch of *L. nigrita* alive and gliding, viewed from the side.

Fig. 2.—The same viewed from beneath, showing the head withdrawn under the mantle.

Fig. 3.—Type of *L. Pritchardi*, from the side, natural size.

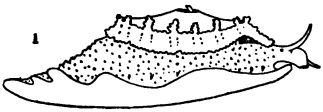
Fig. 4.—Another specimen of the same from above, natural size.

Fig. 5.—Shell of a third specimen of the same from above, natural size.

Fig. 6.—Shell of a third specimen of the same from the side, natural size.

Fig. 7.—Radula of *L. Pritchardi*, magnified.

All figures drawn from life by the writer.



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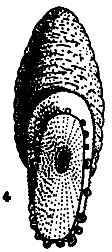

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ART. XIX.—*Notes on Birds.*

By A. J. CAMPBELL.

[Read 8th November, 1894.]

(1) THE OCCURRENCE OF THE SANDERLING *(Calidris arenaria)* IN AUSTRALIA.

Professor Alfred Newton has recorded the following note in the "Records of the Australian Museum" (1892):—"Having lately occasion to investigate the range of the Sanderling *(Calidris arenaria)*, I came across a memorandum made in the year 1860, of my having then seen in the Derby Museum at Liverpool two specimens of the larger race of this species, one in winter dress and the other in incipient spring plumage, both being marked as females, and as having been obtained at Sandy Cove, in New South Wales, 20th April, 1844, by the late John Macgillivray."

I now record a second occurrence in Australia of this extremely interesting wanderer, but in this instance on the west coast, near the North-west Cape. Mr. Tom Carter kindly forwarded a skin to me with the following memorandum:—"I was out with my gun last week (middle of July, 1894), and after a shot at a party of waders I picked up eight Turnstones, two Little Sandpipers *(Tringa ruficollis, ?)*, and two birds as per skin herewith. I take it to be the Sanderling. You will observe there is no hind toe. The other bird was too much smashed to make a skin."

The skin received I passed on to Colonel Legge, who is much interested in the distribution of our *Limicolæ*. He replies, "*Calidris arenaria* in abraded plumage with new winter feathers coming on back and wings."

(2) THE OCCURRENCE OF THE EGG OF THE PALLID CUCKOO *(Cuculus pallidus)* IN THE NEST OF THE MAGPIE LARK *(Grallina picata)*.

My friend, Master John Summers, of Cheltenham, presented me with a nest taken in the locality on the 24th September, 1894, containing a set of five eggs of the Grallina, together with the egg of the Pallid Cuckoo *(C. pallidus)*. This is the first instance I am aware of an egg of this Cuckoo having been found in the nest of a Grallina.

ART. XX.—*The Gymnorhinæ or Australian Magpies, with a description of a New Species.*

By A. J. CAMPBELL.

[Read 8th November, 1894.]

We possess little information about these familiar and favourite birds, and much remains to be learnt respecting them, while it is a matter of surprise that even the knowledge of the geographical range of the various species is so meagre.

The Magpies in their attractive garbs of black and white are indeed emblematical of Australians. They thrive and adapt themselves to almost any part of the continent, are strikingly showy in matter of dress, musical, apt to talk, and if my Australian brethren will permit me to say so, are at times somewhat pert.

It is generally accepted that there are three species or varieties of the genus *Gymnorhina* or so called in vernacular terms—Magpies, and I hope before I finish this article to prove the existence of a fourth, which seems to have been overlooked by previous collectors. Nothing is more delightful than the study of these handsome birds in the open where I have observed the four species. I regret now, as we so often do afterwards, that I did not pay more attention to them when I enjoyed the opportunity.

G. tibicen, Latham (The Black-backed Magpie).

I think we shall find this species ranges from the Gulf of Carpentaria district down through the interior parts of Queensland, New South Wales, and Victoria to South Australia—the focus of numbers being probably in South Queensland, New South Wales, and the Lower Murray district. At early dawn the beautiful piping notes of this Magpie may be heard arising from various belts of timber, but the majority of the birds seldom leave their roost till about sunrise, when they depart singly, in pairs or small companies, to feed upon the plains or other open

ground. They revisit the timber during the day, but towards evening may again be seen on the ground before the various lots hurry in to retire for the night at sundown. At such a time their evensong seems if possible more cheerful. Perhaps five or seven birds will form themselves into the approved art pyramid upon the dead top branches of a gum tree—one bird starts to carol, others chime in, and all conclude in a most joyful chorus as of thankfulness to the departing day.

After the breeding season, and during the winter months, the Magpies congregate in some localities in considerable numbers. This I have more particularly observed in connection with the next species, the White-backed Magpie. Gould says it would appear that the young keep in the company of their parents for the first ten months—that would be till the following pairing season. The pairing season will be found to commence in July, some of the earlier birds laying in August, but the majority lay in September, and the breeding season generally may be said to extend to the end of the year. The nest, which is usually placed in the forked branches of a tree—sometimes a tall, sometimes a low bushy one—is the well known large, open structure built outwardly of dead sticks, twigs and strips of bark, and lined securely inside with a ply of fine bark, grass, hair, feathers, etc. A nest I observed lately on a fringe of Mallee was decorated with numerous long emu feathers artistically interwoven round the rim. The dimensions of the nest, exteriorly, were 33 cm. (13 inches) across by 20¼ cm. (8 inches) deep, the inside measurement being 12¾ cm. (5 inches) in diameter by 9 cm. (3½ inches) deep.

The eggs vary in numbers from three to five, a quartette however being most frequently the complement. There is also considerable difference in the character and colour of the markings of the various clutches, so much so, that it is hard to understand why eggs so totally distinct should be laid by birds of the same species, and that frequently in the same locality. Another "nut" for the theorists on egg-colouration to crack.

As giving an insight into the habits of the Black-backed Magpie I may relate the history of a pair I saw in Riverina lately, breeding close to the homestead at Dunvegan, near Deniliquin. An exceedingly handsome male bird was taken when

young from the bush, reared and allowed his freedom about the place. When he was about two years old, hen-birds from the bush came and coquetted with "Charlie," as he is called, who appeared to pay little heed to his admirers. At last the seductions of one of the hen-birds proved too great, and the pair commenced to build a nest in the nearest tree, not one hundred yards from the house. Charlie proved an exceedingly devoted husband, feeding his mate upon the nest regularly by conveying food from the kitchen table, the meat block, and in fact from anywhere he could steal it. This recurred for seven seasons, the seventh season's brood, I was a witness to, and saw Charlie procuring meat in the kitchen to feed the young. Once Charlie's wing was clipped, when he was forced to climb the tree instead of using flight. On another occasion he unfortunately lost a leg in a trap. It was almost ludicrous to watch how the poor bird used the stump in climbing to assist to feed his offspring. When a brood (usually four in number) was reared honours seemed to be divided, he brought two about the house, while the wild bird enticed her pair into the bush.

Magpies in their natural state mostly procure their food upon the ground, devouring almost anything that creeps or crawls, including lizards and possibly small snakes. Occasionally they eat grain, berries, and other fruit, but those persons who contend that Magpies are granivorous, need only place a bird in a cage, keep it upon grain diet, and note how soon it will die.

It is well known that Magpies can be taught successfully to imitate the human voice in speech. When they attain this accomplishment they invariably drop their own clear wild notes, giving voice occasionally to a loud half-crowing half-whistle-like sound, which is simply abominable as compared with the delightful flute-like cadenza one hears the bird pour forth when in native freedom.

At Warroo, in South Queensland, my venerable friend, Mr. Hermann Lau, once found a Black-backed Magpie's nest containing two eggs of that bird, in addition to a pair of eggs of the Great Cuckoo or Channel-bill (*Scythrops*). He also noted that on the Darling Downs the Magpie usually reared two broods a season, one in August, another about October.

G. leuconota, Gray (The White-backed Magpie).

This showy and splendid species inhabits the coastal regions and more heavily forested parts of New South Wales, Victoria, and South Australia. Whether it extends further west has not been fully determined. In Victoria, south of the Great Dividing Range, the White-backed species is very abundant. It is instructive to observe how that natural barrier divides the two species—the White-backed from the Black-backed variety. During several trips on our main railway line across Victoria, I noted White-backed Magpies very numerous as far as Mount Macedon and Kyneton. Beyond, the numbers seemed to decrease. The first Black-backed birds were seen at Malmsbury and Taradale. The last White-backs were noted beyond Castlemaine at Harcourt and Ravenswood. In the Sandhurst district the tide of Black-blacks had fairly set in, and by the time the plains of the Murray were reached these birds were in great evidence.

As may be expected the natural habits and characteristics of the Black-backed Magpie appear in the White-backed species. However, as Gould experienced, the White-backed birds are more wary and shyer in disposition. To a discriminating ear the delightful clear ringing call is fuller and louder in the White-backed than in the other species. I have endeavoured to class the different notes, of which there appear three kinds at least—the carol or song, a whistle-like call, and a long "squawk"-like note of alarm. The nidification of the White-back likewise resembles that of the other. A nest taken in the Upper Werribee district measured 45¾ cm. (18 inches) across, while the inside dimensions were 20¼ cm. (8 inches) across, by 7½ cm. (3 inches) deep. It was constructed as usual of dead twigs, and lined inside with grass principally, casuarina needles and wool. A complement of from three to five eggs is laid. There is in the Adelaide Museum a curious exhibit, a nest of this species outwardly composed of twisted and crooked pieces of sheep fencing wire. This season I saw taken from some Melaleuca scrub near the coast, a nest composed entirely of wire-like roots, and well-fitted inside with string, pieces of jute, etc. The roots were Melaleuca, and had evidently been taken from a newly grubbed piece of ground near.

I possess a note of this species also breeding in semi-captivity, but in this instance the tame bird was the female. She was two years old when she built a nest on a roof of an outbuilding near my uncle's house, Heyfield, Gippsland. A pair of young were hatched. She was a most persistent nuisance when building her nest—pulling fibre out of door mats, unravelling the edges of oilcloth, etc. One day, after a chance haircutting operation, the bird eagerly seized mouthfuls of hair to finally trim her nest. This bird lost its beautiful native carol, adopting instead the voices of various roosters and other farm-yard fowls.

Some birds, especially old ones, grow very savage, and will attack and strike persons approaching the vicinity of their nest. Once I saw a pair enforce the "move-on clause" on a wedge-tailed eagle, which the magpie attacked from above—every thrust making tufts of feathers fly from between the shoulders of the great bird of prey. I heard of a "hen-wife" who kept a couple of tame magpies about the farm because they encouraged wild ones near, which were a safeguard to her chickens and young poultry against certain birds of prey. If a hawk appeared anywhere in the neighbourhood it usually met with a warm reception from the magpies.

G. dorsalis, n. sp. (The Long-billed Magpie).

The recorded data regarding the geographical range of the *Gymnorhinæ* on the continent, is somewhat perplexing to ornithological students. Gould states in his "Handbook," "It is true that a bird of this genus inhabits the neighbourhood of Swan River (W.A.), whose size and style of plumage are very similar [to *G. tibicen*], but which I have little doubt will prove to be distinct," and in his tabulated list in the West Australian column has inserted *G. tibicen* with a query against it. Yet, under the heading of *G. leuconota*, he says that bird (*G. leuconota*) is called "Goore-bat" by the aborigines of the low-land districts of *Western Australia!* In Dr. Ramsay's "Tabular List" (1883), *G. tibicen* is indicated in the West Australian division, while in his last list (1888) this author has substituted *G. leuconota* without assigning reason for so doing. However, during my own visit to the Western Territory in 1889, I thought the first point might be easily settled as to which of the two species actually inhabits Western Australia.

But to my surprise, on dissecting birds in the bush and observing others in captivity, I found that the mature male bird possessed a *white* back, while the female's was *black*, besides other minor differences, all pointing to a species distinct from either of the eastern forms. For the new variety I would suggest the specific name *dorsalis*, on account of the differential markings of the backs, and to be known on the vernacular list as the Long-billed Magpie, on account of its longer and narrower bill. Perhaps I should say here that during a recent visit of Colonel Legge to Melbourne, I took the opportunity of bringing under his notice examples of the two eastern birds, together with the western forms, and after examination, and without any hesitancy, he concurred in my deductions.

With regard to the range of the western bird I take it to be fairly distributed as far as South-western Australia is concerned, excepting the heavily forested Karri country between King George's Sound and Cape Leeuwin, where I did not observe a single bird. After getting out of the Karri country I noticed the bird in the neighbourhood of Geographē Bay in the more open Jarrah tracts, and along the coast northward. It is said to be found generally throughout the Jam-wood (a species of *Acacia*) country. I noted it as far south as Cranbrook, on the overland railway, sixty-seven miles from Albany. A few, I am informed, occur on the Upper Murchison and Gascoyne districts, and as far north as the Hammersley Range plateau.

At Geraldton, Champion Bay, I had an opportunity of examining a very fine female bird in a state of domestication. By the way, she rejoiced in the name of "Jacob." She was an intensely amusing bird and full of mischievous glee. I should have mentioned that, although the native notes of the western Magpie resemble those of its eastern congeners, the western type seems to lack that hilarity of song so noticeable in both the eastern birds.

The nest, together with a set of eggs of the western species, has already been described by me in the "Proceedings" of this Society, 1890, but for the sake of comparison I may repeat, the nest was constructed outwardly of sticks and twigs, lined inside with bark, which succeeded a ply about $2\frac{1}{2}$ cm. (1 inch) in thickness of finer bark. Measurements across all about 30 cm. ($11\frac{3}{4}$ inches) inside

dimensions 15 cm. (6 inches) across by about $6\frac{1}{2}$ cm. ($2\frac{1}{2}$ inches) deep.

September, October and November constitute the chief breeding months.

G. hyperleuca, Gould (The Lesser White-backed Magpie).

Fourthly and lastly, the Tasmanian Magpie is an insular form of the White-backed Magpie of the continent. Considering that the Tasmanian forms of the same species of the mainland birds are usually larger, it is worthy of remark that the Tasmanian Magpie is smaller—an additional fact, perhaps tending to prove it is a good species and not merely a smaller race of *G. leuconota.* Likewise, it is a curious fact that, although some of the birds peculiar to Tasmania—including a *Strepera* closely allied to *Gymnorhina*—are met with on the larger intermediate islands in Bass Straits the Magpie is altogether absent.

Tasmania was the first colony that extended protection to Magpies, as birds of usefulness, consequently, through not been molested, one finds them exceedingly tame, even sometimes building their nests in trees by the wayside of thoroughfares and streets. I was greatly entertained one day by a Magpie, perched upon a three-railed fence, piping its merry song to a railway train which whizzed past within a few paces of the bird.

The Tasmanian Magpie usually lays three or four eggs, but I have heard of sets of five as with the mainland species. The breeding season is from August to the end of the year. Mr. Arthur E. Brent, from his own observation, informs me, that these birds are not at all particular what they use as constructing material for a home. One nest he saw was built of the wire which bound sheaves of grain, and which was thrown in a heap after threshing. Mr. Brent also observed another nest which was constructed of reaper and binder twine. This nest was lined with horse manure. But of course these are merely exceptions, the nest usually resembling those of the other Magpies. Underneath and adjoining a nest of this Magpie I, on one occasion, found the smaller nest of the Yellow-tailed Tit *(Geobasileus).* The fact, however, is not new, for collectors on the mainland have not unfrequently met with similar instances.

Descriptions of Birds.

Gymnorhina tibicen.

Adult male.—Glossy bluish-black, except portions of the under-parts and primaries, which are of a more brownish tinge, and except nape and hind neck, upper and under wing coverts, edge of wing, upper and under tail coverts, tail (except a broad terminal band and outer web of either of the outermost feathers) and vent, white. Bill, bluish-white, graduating through blue horn colour into bluish-black at the tip; irides, light hazel; legs, black.

Adult female.—Differs in possessing a more brownish tinge throughout the black plumage, and by having the nape and hind neck, and lower back grey instead of white.

Young.—Most resemble the female, with the dark portions of the plumage brownish-black.

Gymnorhina leuconota.

Adult male.—Black generally, more glossy on some portions, and brownish tinged on other parts, except nape and hind neck, back, upper and under wing coverts, edge of wing, upper and under tail coverts, tail (except the terminal band and outer web of either of the outermost feathers) and vent, white. Bill bluish-white, graduating through bluish-slate into bluish-black at the tip; irides, light hazel; legs, black.

Adult female.—Differs in having the black portions of the plumage not so intense in colour, and by having back of neck and back grey; some of the feather shafts, particularly on the back, showing a fine dark stripe.

Young (from the nest).—Most resemble the female. In some instances, excepting on the head, the dark portions of the plumage are rusty brown.

"Immature birds, of both sexes, have the whole of the back clouded with grey, and the bill of a less pure ash colour."—(Gould).

Gymnorhina dorsalis.

Adult male.—Resembles most the male of *G. leuconota*, but is smaller in size, bill narrower, more curved and longer, edge of wings slightly mottled instead of white, and the black terminal

band of the tail narrower and more concentric in form. Bill, bluish-white graduating through bluish horn colour into bluish-black at the tip; irides, hazel; legs, black.

Adult female.—Differs conspicuously in having the back black instead of white; back of neck and lower back being of a mottled appearance where the dark feathers are tipped with white, the mottle at back of neck blending into a white nape; the otherwise black plumage is browner in tone than on the male, especially on the under parts and primaries.

Gymnorhina hyperleuca.

Adult male.—Glossy bluish-black or glossy black, except nape, hind neck, back, upper and under wing coverts, upper and under tail coverts, tail (except the terminal band and outer web of either of the outermost feathers) and vent, white; edge of wing, white mottled with black; bill, bluish horn colour graduating into black at the tip; irides, clear or bright hazel; legs, black.

Adult female.—Differs in having the hind neck and back grey, and the primaries and terminal band of the tail brownish-black.

COMPARATIVE DIMENSIONS IN INCHES.

Species.	Total length.	Culmen.	Wing.	Tail.	Tarsus.
G. tibicen (male) - -	15·75	2	10·1	6	2
(female) -	15·75	1·7	9·7	6	2
G. leuconota (male) -	17	2·18	11·5	7·25	2·5
(female) -	16·25	2.06	10·75	6	2·25
G. dorsalis (male) -	15·5	2·31	10·25	6·1	2·1
(female) -	16	2·18	10·5	6·25	2·2
G. hyperleuca (male) -	13·5	1·75	9·4	5·5	2

MR. EDWARD DEGEN, THE PTEROLOGIST, HAS MOST KINDLY FURNISHED ME WITH THE SUBJOINED COMPARATIVE STATEMENT, SHOWING THE DETAILED COLOURING OF THE BASTARD WINGS AND UPPER WING COVERTS.

Names of Species.	Bastard Wing.	Covert Feathers of the Primaries.	Covert Feathers of the Secondaries.
G. tibicen (male) - -	First feather black entirely, 2nd and 3rd white on outer web.	White commences on the 4th feather on outer web. Same on 5th and 6th, extending nearly to the tip. 7th feather and following ones quite white.	First feather pure white. 2nd to 6th white with black at the base of inner web.
G. leuconota (male) -	First feather black with trace of white. 2nd and 3rd white. The latter not extending so much as on above.	White commences on the 5th on outer web only. The same arrangement applies to the series as far as the 9th.	Showing black on the base of all feathers, also on tips of inner web.
G. dorsalis (male) -	First and 2nd feathers black. 3rd showing white at its base only.	Same as in the above species. The inner webs of the 8th and 9th showing white also.	Inner webs black throughout, differing from both the other species. Outer webs white.
G. dorsalis (female) -	First feather same as above. 2nd showing white, also 3rd.	Fifth, 6th and 7th whiter on outer webb, 8th, 9th and 10th white, extending over portion of inner web too.	Same as above.
G. hyperleuca (male) -	First and 2nd feathers black. Two-thirds of outer web white on 3rd and 4th.	Outer webs of 5th, 6th, 7th and 8th white, but not reaching to tips of feathers. 9th and 10th (not ascertained, specimens moulting), presumably the same throughout the series.	All white, with the exception of 2nd, 3rd and 4th, where the white does not reach the tip on the inner web, leaving a small black spot.

Descriptions of Eggs.

Black-backed Magpie *(G. tibicen)*.—Eggs, although varying in shape, are chiefly of a lengthened form; the texture of the shell is somewhat fine but lustreless. There are many different characteristics of colouring. Three types may be singled out for description: *(a)* Ground colour bluish or French grey, beautifully marbled nearly over the whole surface with streaks, dashes and smudges of pinkish- or brownish-red. In some instances the markings form a confluent patch about the apex. *(b)* Other specimens are more greenish in ground colour, and are clouded or blotched with drab. *(c)* Another set has a greenish ground colour but instead of reddish streaks is moderately marked with large roundish spots and blotches of umber and dull slate, most of the blotches having penumbra-like edges. Faint traces of hair-like lines also appear upon the surface of the shell. A full clutch taken in Riverina measures, in centimetres: (1) 3·65 x 2·65; (2) 3·7 x 2·69; (3) 3·72 x 2·68; (4) 3·65 x 2·76; (5) 3·67 x 2·72. Another set, I took in Queensland, gives: (1) 3·78 x 2·82; (2) 3·9 x 2·8; (3) 3·81 x 2·78.

White-backed Magpie *(G. leuconota)*—Three types of eggs may be again selected as the most common, all somewhat lengthened and elegant in form. *(a)* Ground colour light or pale green, almost hidden with streaky and cloudy markings of pinkish-red. *(b)* In others the markings are drab or brown. *(c)* These examples have a plain grey (sometimes greenish) ground colour, and, like the type "*c*" in *G. tibicen* are moderately, almost sparingly, marked with roundish spots and blotches of umber and dull slate. I possess exceptional examples of a beautiful bluish-green colour devoid of markings save a few indistinct freckles of chestnut. Dimensions, in centimetres, of a clutch of type "*b*": (1) 4·02 x 2·72; (2) 4·0 x 2·65; (3) 3·88 x 2·75. A clutch in type "*c*": (1) 3·97 x 2·86; (2) 3·96 x 2·81; (3) 3·97 x 2·8.

Lesser White-backed Magpie (*G. hyperleuca*).—Eggs lengthened in form, light greenish ground colour mottled and marked all over with umber. Another class of specimens which, however, is not so common, is rounder in form and more of a distinct greenish colour, moderately marked as in type "*c*" of the preceeding species, with roundish blotches of umber. Interspersed are also

a few wavy markings. Dimensions, in centimetres: Clutch—long examples: (1) 3·88 x 2·77; (2) 3·7 x 2·69; (3) 3·45 x 2·5. Two, from a clutch of four—round examples: (1) 3·61 x 2·77; (2) 3·57 x 2·87.

Long-billed Magpie (*G. dorsalis*)—The West Australian eggs exhibit less variety of colouring and more resemble the "*a*" type in both those of *G. tibicen* and *G. leuconota*. The form is long and elegant, ground colour varying from bluish-grey to greenish-grey in tone, beautifully streaked or marbled all over with rich pinkish-brown. The following are the dimensions, in centimetres, of three clutches:—

a—(1) 3·96 x 2·8; (2) 3·86 x 2·76; (3) 4·33 x 2·68.
b—(1) 4·3 x 2·75; (2) 4·12 x 2·7; (3) 4·19 x 2·68.
c—(1) 4·23 x 2·71; (2) 4·02 x 2·7; (3) 3·65 x 2·64.

ART. XXI.—*Australian Fungi.*

By D. McALPINE, F.C.S.

[Read 8th November, 1894.]

In 1892 a "Handbook of Australian Fungi" was published by Dr. M. C. Cooke, under the authority, and with the assistance, of the several Governments of the Australian colonies. This was a very useful and necessary publication, as it gave workers, or intending workers, in this division of the subject, a substantial basis to start from, and since then various additions have been made. But, as Dr. Cooke points out, the minute fungi requiring a pocket lens for their detection, have been largely over-looked by those collectors who sent home specimens for determination, so much so that, as he states in the introduction, "It is quite probable that in the course of a few years by working up the minute species, the total number contained in this volume would be more than double, even without the investigation of unexplored districts."

It is to these minute species that I am now giving attention, and this first instalment may perhaps encourage other workers in the same field, for truly "the harvest is plenteous, but the labourers are few." I am indebted to several correspondents for a number of the specimens herein described, and they deserve full credit for their praiseworthy labours.

1. Mr. F. Barnard, senior, of Kew, one of the old microscopic workers of the colony, has quite a number of specimens awaiting determination, and as many of them are mounted microscopically, this should facilitate the work.

2. Mr. L. Rodway, of Hobart, Tasmania, who is doing good work among the Phanerogams of that island, has also sent me a number of selected specimens.

3. Mr. G. H. Robinson, of Ardmona, has been most unremitting in his attention to these minute forms. He is a gold medallist of Longerenong Agricultural College as well as a former distinguished student of the School of Horticulture, Burnley, and his trained powers of observation have enabled him to detect many minute

forms of fungi while engaged in his ordinary avocation as a fruit-grower.

The forms recorded are either new to science or to the colonies, or have been found upon new host plants or in fresh localities, and since they are all parasitic fungi, preying upon some form of vegetable life, they are therefore of special interest to the vegetable pathologist.

They are arranged according to the plan laid down in my paper read before the Australasian Association for the Advancement of Science, at Adelaide (1893), on "Botanical Nomenclature, with special reference to Fungi." There are twelve groups altogether, eight of which are represented here. Of the twenty-eight species recorded, eight are new, in addition to one new variety.

Group III.—Uredines.

ORDER UREDINACEÆ.

(1) *Melampsora Lini*, Tul.

Leaves of *Linum marginale*, Hobart, Tasmania (Rodway, 33).

(2) *Puccinia Burchardiae*, Ludw.

Uredospores.—Sori amphigenous, bullate, elliptical or sometimes circular, crowded, light brown, erumpent, surrounded at base by dry cuticle of epidermis.

Uredospores globose or oval, yellowish-brown, epispore echinulate, $25 - 28 \cdot 5\mu$ in dia., or $28 \cdot 5 - 31 \cdot 5\mu \times 22 - 25\mu$.

On stem and leaves of *Burchardia umbellata*. October. Cheltenham, near Melbourne, Victoria.

This species was described from South Australia by Professor Dr. F. Ludwig, in "Zeitschrift für Pflanzenkrankheiten," vol. iii., pt. 3, 1893, but no uredospores were found. The above description supplies the omission.

(3) *Puccinia Correæ*, McAlp., n. sp.

Hypophyllous. Sori cushion-shaped, circular or interruptedly circular, dirty brown, scattered, soon naked.

Teleutospores yellowish-grey, long stalked, elongated fusoid, constricted at middle; upper cell elongated, tapering and rounded

at apex; lower cell tapering towards base; $44-60 \times 17-20 \cdot 5\mu$. Pedicel light grey, several times as long as teleutospore.

Mesospores similarly coloured and stalked, ovoid with truncated apex, $25-28 \times 16-19\mu$.

On under surface of leaves of *Correa Lawrenciana.* Very common on one bush in damp gully, but never found on any other, although plant is common. December. Eastern slope of Mount Wellington, Tasmania (Rodway, 6).

The sori stand out very distinctly from the cinnamon-brown under surface of the leaves, causing corresponding circular depressions on upper surface, of a yellowish-green colour.

(4) *Puccinia Erechtitis*, McAlp., n. sp.

Æcidiospores.—Æcidia on stem and leaves, causing distortion and swelling, pale yellow at first, becoming orange-yellow, arranged close together in lines or irregularly. Pseudoperidia cup-shaped, with white, torn, revolute edges. Æcidiospores variable in shape, irregularly round or oval, orange-yellow, smooth, $19-16\mu \times 17-12\mu$. Very common all the year round, except during middle of summer.

Teleutospores.—Sori for a long time covered by epidermis, black, crowded together and forming a swelling. Teleutospores yellow-brown, pedicellate, elongated, constricted at middle; upper cell dark brown, rounded or pointed and thickened at apex; lower cell usually yellow and tapering towards base, elongated, wedge-shaped, $54-57\mu \times 19-25\mu$. Pedicels persistent, very pale yellow, to transparent, 38μ long. Found from April to June, but very rare.

On *Erechtites quadridentata?* Ardmona in Goulburn Valley, Victoria (Robinson, 107).

(5) *Puccinia Hieracii*, Mart.

Uredospores.—Sori on upper and less often on under surface of leaves, dark purplish-brown, numerous, scattered, becoming confluent, bullate, surrounded by torn epidermis. Uredospores globose or elliptic, golden-brown, finely echinulate, about $28 \cdot 5\mu$ in dia., or $33-27\mu \times 25\mu$.

Teleutospores.—Along with uredospores. Sori blackish-brown, usually confluent, on much withered basal leaves. Teleuto-

spores reddish-brown, stalked, elliptic, upper and lower cell about same size; upper cell rounded and not thickened at apex, hemispherical; lower cell somewhat similar, but often tapering towards base, average $38 \times 22\mu$, pedicel transparent, deciduous.

On leaves and flowering stems of *Hypochæris radicata.* All the year round when moisture is present, but especially common about April and May, and September to November. Ardmona, in Goulburn Valley, Victoria (Robinson, 86, 96).

The presence of the fungus seems to check flowering, or at least, to retard development greatly, for healthy plants are met with flowering freely, while diseased specimens are conspicuous by the absence of flowers. The leaves begin by assuming a pale green to yellowish tint, then turn snuff-brown and shrivelled. This form approaches *P. caulincola*, Corda, found by Cooke on *Hypochæris glabra* from Queensland, and which he considers may possibly be a form of *P. Hieracii.*

(6) *Puccinia Hypochaeris*, McAlp., n. sp.

Æcidiospores and Teleutospores occurring together on both surfaces of leaf.

Æcidiospores.—Pseudoperidia amphigenous, on greenish-yellow to brownish orbicular patches, clustered, orange-yellow, round to elliptical. Aecidiospores subrotund to oval, pale orange-yellow, $14 - 16\mu \times 12{\cdot}5\mu$.

Teleutospores.—Sori intermixed with æcidia, black, elliptical, sometimes run together, girt by ruptured epidermis, sometimes exactly opposite each other on upper and under surface of leaf. Teleutospores chestnut-brown, pedicellate, constricted at middle; upper cell dark brown, rounded or scoop-shaped, thickened at apex; lower cell pale brown, usually tapering towards base; $47 - 50\mu \times 19 - 23\mu$. Pedicels hyaline, sometimes persistent, about length of one of the cells, viz., 24μ.

On leaves of *Hypochæris radicata.* October. Ardmona, in Goulburn Valley, Victoria (Robinson, 117).

This species belongs to the group *Pucciniopsis*, Schroet., in which only Æcidiospores and Teleutospores are known, occurring on the same host plant.

(7) *Puccinia Plagianthi*, McAlp., n. sp.

Sori reddish-brown, naked, bullate, scattered. Teleutospores shortly-stalked, yellowish, clavate, slightly constricted in middle; upper cell rounded at apex; lower cell usually tapering towards base, sometimes a counterpart of the upper, similarly coloured; pedicel hyaline, $50 \times 22\mu$.

Very common on leaves and flowers of *Plagianthus sidoides.* August to April. Southern slope of Mount Wellington, Tasmania (Rodway, 11).

(8) *Æcidium eburneum*, McAlp., n. sp.

Æcidia ivory colour becoming brownish, clustered together without definite order. Pseudoperidia cup-shaped, minute, margin finely toothed. Æcidiospores subglobose or elliptical, grey, from 24 to 25 μ in diameter, or $25 - 28 \times 19 - 22\mu$. On stems, leaves, flower-stalk, calyx and legumes of *Bossiæa cinerea.* October and November. Caulfield and Boxhill, near Melbourne, Victoria (Barnard, 1). Bellerine Swamp, Tasmania (Rodway, 15).

In the Tasmaniam specimens the æcidia are confined to the fruit.

(9) *Æcidium monocystis*, Berk.

On *Abrotanella forsterioides.* Summit of Mount Wellington, Tasmania (Rodway, 30).

(10) *Æcidium Ranunculacearum*, D. C.

On *Ranunculus parviflorus.* Ardmona in Goulburn Valley, Victoria (Robinson, 90).

Group IV.—Pyrenomycetes.

ORDER HYPOCREACEÆ.

(11) *Claviceps purpurea*, Tul.

On *Lolium perenne*, *Lolium temulentum*, *Triticum sativum*, etc., Victoria.

ORDER FOLIICOLACEÆ.

(12) *Sphaerella Fragariæ*, Sacc.

On leaves of strawberry. Victoria, South Australia, and recorded for New South Wales by Dr. Cobb.

This is becoming a very widespread and serious disease of the strawberry plant.

GROUP V.—DISCOMYCETES.

ORDER PHACIDIACEÆ.

(13) *Pseudopeziza Medicaginis*, Sacc.

Sporidia, $9 \times 4 \cdot 5\mu$.

On both surfaces of leaflets of *Medicago sativa*.

Very common nearly all the year round. Ardmona, in Goulburn Valley, Victoria. (Robinson, 90).

GROUP VII.—HYPHOMYCETES.

ORDER MUCEDINACEÆ.

(14) *Monilia fructigena*, Pers.

On apples, pears, etc. Victoria.

(15) *Oidium Chrysanthemi*, Rabh.

On leaves of chrysanthemum. Victoria.

(16) *Oidium Oxalidis*, McAlp., n. sp.

Broadly effused, greyish, powdery. Hyphæ septate, branched, $4 - 6\mu$ broad. Conidia oval to barrel-shaped, granular, hyaline $31 \times 12\mu$.

Mostly on upper surface of leaves, sometimes on lower, also on leaf-stalks, stem and fruit of *Oxalis corniculata*. Very common, especially on irrigation patches wherever there is moisture. Ardmona, in Goulburn Valley, Victoria. June to November and right through summer on banks of irrigation channels (Robinson, 103).

ORDER DEMATIACEÆ.

(17) *Scolecotrichum graminis*, var. Avenæ, Erikss.

On leaves of oats (*Avena sativa*). Victoria.

GROUP VIII.—SPHÆROPSIDES.

ORDER SPHÆRIOIDACEÆ.

(18) *Septoria Dianthi*, Desm.

On carnations. September. Near Melbourne, Victoria.

(19) *Septoria Tritici*, Desm.

On fading leaves of wheat, also stem and ear. Victoria, and recorded for New South Wales by Dr. Cobb.

(20) *Phleospora Mori*, Sacc.

On leaves of mulberry. Victoria.

ORDER MELANCONIACEÆ.

(21) *Marsonia deformans*, Cooke and Mass.

On leaves and stipules of cultivated peas. September. South Australia.

GROUP X.—USTILAGINES.

ORDER USTILAGINACEÆ.

(22) *Ustilago Allii*, McAlp., n. sp.

Sori forming minute dark coloured pustules in parallel lines along veins of scale leaves of bulb, at first covered by the epidermis, then pulverulent, black, in streaks or blending into masses.

Resting-spores dark brown, spherical, echinulate, imbedded in gelatinous mass, $4 - 4\frac{1}{2}\mu$. in dia. Jointed mycelium here and there in gelatinous mass, 3μ. broad. On scale leaves of stored onion bulbs. Ardmona, in Goulburn Valley, Victoria. (Robinson, 97).

(23) *Ustilago Poarum*, McAlp., n. sp.

Only found on stunted plants so far, distorting, discolouring, and forming black powdery masses, especially on the foliage.

Resting-spores globose or irregularly spherical, yellowish-brown, epispore echinulate, $12\frac{1}{2}\mu$ in dia., or $14 \times 12\frac{1}{2}\mu$.

On very small specimens of *Poa annua*, growing in hard ground. October. Ardmona, in Goulburn Valley, Victoria (Robinson, 82).

(24) *Urocystis occulta*, Preuss.

On wheat plants, very destructive to crop. Victoria; and recorded for New South Wales by Dr. Cobb.

Group XI.—Phycomycetes.

ORDER PERONOSPORACEÆ.

(25) *Peronospora parasitica*, De Bary., var. Lepidii, McAlp.

Dense white mould on leaves and other parts of plant, which soon curl, and the fungus forms a felt almost covering the entire surface.

Gonidiophores straight, averaging 6μ thick. Gonidia elliptical, pale grey, $35-41\mu \times 19-22\mu$; membrane about 1μ thick, hyaline, protoplasm granular, with a homogeneous layer between it and membrane, germ-tube issuing laterally.

On leaves, stems and fruit of *Lepidium ruderale*, causing distortion. The lower surface of leaf is attacked first, causing it to curl up. After autumn rains and in spring. Ardmona, in Goulburn Valley, Victoria (Robinson, 108).

The variety principally differs from *P. parasitica* in the stalk of the gonidiophore being straight and not flexuous, and in the shape and size of the gonidia, being sometimes twice as long as broad, and altogether larger.

(26) *Peronospora Schleideni*, Unger.

Common on leaves of onion, shallot, and various species of *Allium*. Victoria.

ORDER ENTOMOPHTHORACEÆ.

(27) *Empusa Muscæ*, Cohn.

On dead house flies (*Musca domestica*). Victoria.

Group XII.—Myxomycetes.

(28) *Plasmodiophora Brassicæ*, Wor.

Causing "club-root" in turnips, cabbages, cauliflower, and other cruciferous plants. Victoria.

ART. XXII.—*Preliminary Notice of two new Species of Marsupials from Central Australia.*

By BALDWIN SPENCER

(Professor of Biology in the University of Melbourne).

[Read 8th November, 1894.]

The following is a brief description of two new forms of Marsupials obtained in Central Australia during the visit of the Horn Scientific Expedition to the Macdonnell Ranges. The full descriptions, together with illustrations, are reserved for the volume in which it is intended to publish the complete results of the expedition.

(1) *Phascologale macdonnellensis.*

Size medium. Fur somewhat coarse. General colour of back dull greyish-brown with a well-marked chestnut patch behind each ear. Ventral surface grey. The eye is, more or less, surrounded by a light coloured ring, and a light line runs along the upper and under jaws bordering the mouth.

Ears rounded, clothed inside and out with short hairs, reaching when laid forward to about the centre of the eye.

Hands and feet grey. Palms with six striated pads, the proximal half of the pollical pad curved, and with the concavity facing towards the pollex; the proximal outer pad V-shaped, with the apex pointing towards the fingers, the inner leg of the V being slightly longer than the outer.

Soles naked, except under the heel where they are hairy; granulated; hallucal pad divided into two; hallux reaching slightly further than the proximal end of the anterior pads. Pads, six in all, and striated.

Tail shorter than the head and body combined, and notably stout in its proximal half, tapering rapidly about the middle of its length, and from this gradually to the tip. Incrassated. Covered with fairly long stiff hairs. In colour somewhat lighter

than the body, the ventral being slightly lighter than the dorsal surface.

Pouch slightly developed and formed by two lateral folds of skin. Within the pouch area the hairs are comparatively scanty and white in colour; external to the pouch area the hairs are dark coloured for their basal two-thirds the pouch area being thus clearly marked out, and the folds being doubtless more prominent when young are present. Mammæ six (three on each side).

Dentition $i.\ \frac{1.2.3.4}{1.2.3.}.\ c.\ \frac{1}{1}.\ p.\ \frac{1.0.3.4}{1.0.3.4}.\ m.\ \frac{1.2.3.4}{1.2.3.4}.$

Dimensions of Female (in al.).

Head and body	...	...	92 mm.
Tail	...	...	...	77 ,,
Hind foot		...	...	14 ,,
Ear	...	...	...	13 ,,

Habitat.—Central Australia (Alice Springs). Terrestrial, living in holes amongst rocks and under stones.

The first specimen was found by Mounted Trooper South, of Alice Springs, and by him presented to Dr. Stirling, for whom it had been intended, who kindly handed it on for description to me as officer in charge of the zoological department of the expedition.

(2) *Sminthopsis psammophilus*, sp. n.

Size medium. Fur close, long, and fine. Dorsal surface dark grey. Ventral surface of head and body white. Brownish tinge on the thighs. Tail with short, stiff whitish hairs dorsally, and black hairs beneath increasing in length dorsally and ventrally at the tip, so as to form a slight crest.

Ears large, reaching half-way between the eye and the pit of the snout; covered back and front with short stiff grey hairs. Palms granulated with six unstriated, and not clearly outlined, pads.

Soles hairy; the hairs covering the surface to the base of the pads, with the exception of a narrow granulated central space, reaching back from the pads to the hallux. Pads, three in

number, without striations and granulated. Hallux small, about half-way between the heel and the tips of the toes.

Mammæ? (only a single male specimen obtained).

Dentition $i. \frac{1.2.3.4}{1.2.3.}$. $c. \frac{1}{1}$. $p. \frac{1.0.3.4}{1.0.3.4}$. $m. \frac{1.2.3.4}{1.2.3.4}$.

DIMENSIONS OF MALE (in al.).

Head and body	...	...	105 mm.
Tail	...	...	116 ,,
(Very tip broken off).			
Hind foot	...	...	25 ,,
Ear	...	...	24.5 ,,

Habitat.—Central Australia, near Lake Amadeus. Terrestrial. Our attention was drawn to the first specimen seen, by Mounted Trooper Cowle as we were riding over sand-hills covered with tussocks of porcupine grass (*Triodia irritans*). It ran about from tussock to tussock. A second specimen was seen in the same district but not captured, and Mr. Cowle has since informed me that he has seen the same animal near Illamurta in the James Range.

Art. XXIII.—*Contributions to the Palæontology of the Older Tertiary of Victoria.*

Lamellibranchs—Part I.

(With Plate XII.)

By G. B. Pritchard.

[Read 8th November, 1894.]

By far the greater number of our Eocene Lamellibranchs have been described by Professor R. Tate of the University of Adelaide, and much credit is due to him for the treatment they have received at his hands. The Rev. J. E. Tenison Woods takes the next position, with a large number of species to his credit. For the remaining few we are indebted to the labours of Professor Sir F. McCoy, Professor Hutton, Professor Zittel, and Mr. R. M. Johnston. Since the above gentlemen wrote there have been very few new species added to this class, and as I have been fortunate enough to procure a few which are in want of names I will proceed to give their diagnoses.

Trigonia tatei, sp. nov.

(Plate XII., figs. 1, 2, 3.)

Shell thick, rotundate rhombic, somewhat convex, the antero-posterior diameter only differing in length from the umbo-ventral by about one or two millimetres; anterior margin broadly rounded, ventral margin nearly straight or very slightly convex, posterior margin nearly straight abruptly truncated making an angle of 145° with the hinge line, post-dorsal margin straight or slightly angled medially. Posterior slope convex, and ornamented with from 6 to 9 radiating obtusely rounded ribs, the siphonal ridge being by far the strongest and widest, interspaces wider than the ribs and showing the concentric lines of growth, ribs spinulosely ornamented, when worn generally nodulose, occasionally smooth; on the slope immediately under the dorsal margin [escutcheon] there are five very faint thread-like ribs

minutely spinulose near the beak. Middle and anterior portion of the valve bearing narrow-rounded undulating transverse ridges; the middle portion or that immediately anterior to the siphonal ridge being crossed by what appear to be impressed lines, number variable, generally about ten, frequently less, radiating from the beak to the ventral margin, shows the ripple-like ridges broken up into quadrangular nodes.

Dimensions.—Average of a number of specimens, antero-posterior diameter, 39 mm.; umbo-ventral diameter, 37 mm.; thickness through one valve, 11·5 mm.; thickness of shell, 3 mm. The largest example of the species I have yet seen has the following dimensions, antero-posterior diameter, 55 mm.; umbo-ventral diameter, 49 mm.; thickness of shell, 3·5 mm.

Locality.—Abundant in the Lower Eocene calcareous sands, Moorabool Valley, near Maude.

Observations.—This species may at first sight be confounded with *T. semiundulata*, McCoy, to which it is closely related, but upon examination may be easily distinguished from Sir F. McCoy's species by its much thicker, more solid, and more regularly convex shell, not so attenuate posteriorly, by the greater angle the posterior margin makes with the hinge line, the absence of flattening of the posterior slope, the straighter ventral margin, the smaller number of posterior radial ribs, and the less crowded transverse ridges. From our other fossil species of this genus, namely, *T. howitti*, McCoy, *T. acuticostata*, McCoy, and *T. tubulifera*, Tate, it is still more readily separable, as the first two have, like the recent species, radial ribbing only, while the third is a minute shell with well developed tubular projections on the transverse ridges as well as on the radial ribs.

The first examples of this species that came under my notice were in the collection of the Rev. A. W. Cresswell, M.A., of Camberwell, who had obtained his specimens from the Maude district. Subsequently I had an opportunity of visiting this district in company with Mr. T. S. Hall, and was able to collect a large series of specimens.

Species name in compliment to Professor Ralph Tate of the Adelaide University.

MYOCHAMA TRAPEZIA, sp. nov.

(Plate XII., figs. 8, 9.)

Shell trapezoidal elongate, moderately thick. Left valve free and very slightly convex, convexity more marked in the neighbourhood of the umbo, umbo sharply pointed and incurved immediately over the well marked triangular cartilage pit, anterior margin straight, dorsal margin straight, making an angle of 110° with the anterior margin and truncated at an angle of 125° posteriorly, anterior and posterior margins slightly rounded to join the convex ventral margin. Ornamented with concentric ridges or corrugations separated by somewhat broader shallow interspaces, a few faint radial wrinkles on the posterior slope. Right valve convex, frequently only partially attached by a limited portion of the dorsal surface, umbo free and ornamented with regular narrow concentric ridges, the concentric corrugations of the unattached ventral portion of this valve generally not so well defined as those of the left valve, faintly radially wrinkled anteriorly and posteriorly.

Dimensions.—Average right and left valves antero-posterior diameter, 26 mm.; umbo-ventral diameter, 18 mm.; largest example antero-posterior diameter, 29 mm.; umbo-ventral diameter, 22 mm.

Locality.—Eocene blue clays of Curlewis, Bellarine Peninsula. —Six examples. Eocene, lower beds at Muddy Creek, near Hamilton.—One example.

Observations.—It is only recently that any fossil species of this genus have been recorded from the Victorian Tertiaries. Professor Tate, in a paper* on "Unrecorded Genera of the Older Tertiary Fauna of Australia," describes and figures two new species under this genus, *M. plana* from the Miocene of the Gippsland Lakes, and *M. rugata* from the Eocene of Spring Creek, and of the Gellibrand River. The new species herein described is closest related to *M. plana*, Tate, but differs from it most noticeably in outline, and in the more regular and well-developed concentric ridges, and in the absence of any umbonal radial corrugations. The new species appears to be commonly only partially attached by a limited portion of the dorsal region of the right valve to

* Proc. Roy. Soc. N.S.W., 1893.

such organisms as polyzoa, and on that account in all the specimens yet to hand the shape is fairly constant; but should wholly attached valves occur, as is not unlikely, the shape would then necessarily be greatly dependent upon the surface of attachment.

PINNA CORDATA, sp. nov.

(Plate XII, figs. 4, 5.)

Shell thin, triangular, elongate; valves very convex; dorsal half bearing about ten smooth longitudinal ribs increasing in breadth posteriorly, with shallow interspaces which also become broader posteriorly, but much more rapidly than the ribs; dorsal slope abrupt apically, becomes more gradual posteriorly, ultimately similar to the ventral slope; ventral half with numerous close-set concentric lines of growth, and broad well defined undulations parallel to the lines of growth becoming obsolete before reaching the dorsal ribs. In juxtaposition to the well defined dorsal ribs, and on the ventral slope there are four or five very faintly developed close and narrow longitudinal ribs becoming slightly stronger posteriorly. Dorsal margin at first straight, then rapidly ascending, giving it a distinctly concave aspect; ventral margin concave about the byssal orifice, then rapidly ecurved becoming regularly convex to the posterior end; posterior margin incomplete, apparently, from the aspect of the shell, gently rounded from the ventral margin.

Dimensions.—Length of dorsal margin (incomplete), 110 mm.; width, 55 mm.; greatest thickness through both valves, 39 mm.

Locality.—Eocene sandy limestones, Barwon River, near its junction with the Native Hut Creek. One example collected by Mr. J. Betheras.

Observations.—This species seems to be closest related to the South Australian Miocene species, *P. semicostata*, Tate, from the oyster beds of Adelaide and Aldinga Bay, but as far as I have been able to make out from Professor Tate's description and figure, the present species is a relatively narrower and more convex form, with a much more abrupt dorsal slope apically, and is without scales on the longitudinal ribs.

CARDITA MAUDENSIS, sp. nov.

(Plate XII., figs. 6, 7).

Shell thick, rotundate oblong, somewhat depressed; umbo prominent incurved anteriorly; anterior region small, anterior margin gently convexly rounded to join the slightly convex ventral margin; dorsal margin straight, obtusely truncate posteriorly, some examples, particularly young shells, are not so noticeably truncate posteriorly, but appear slightly shorter and have their margins more regularly convexly rounded. Lunule small, depressed, narrow, elongate, cordate. Surface ornamented with nineteen or twenty comparatively broad closely nodulose radiating ribs, separated by narrower shallow concave interspaces, in which the concentric lines of growth are visible. The nodulose ornamentation of the ribs may be truncated spines, as some examples are inclined to be rather spinose anteriorly and posteriorly. Inner margin of the valves coarsely denticulate.

Dimensions.—Antero-posterior diameter, 10 mm.; umbo-ventral diameter, 9 mm.; thickness through both valves, 7 mm.

Locality.—Lower Eocene calcareous sands, Moorabool Valley near Maude. Fifteen examples.

Observations.—This species appears to be somewhat related to *C. delicatula*, Tate, and *C. tasmanica*, Tate, but from the former it differs by not being so abruptly truncate posteriorly, by the umbones not being so anterior, and by the fewer, broader, and much more coarsely ornamented ribs, and from the latter, apart from shape and dimensions, the present species has fewer and broader ribs and much narrower interspaces between the ribs.

CHIONE HALLI, sp. nov.

(Plate XII., figs. 10, 11, 12.)

Shell thin, tranversely oval, moderately convex as a rule, though occasional examples are somewhat depressed; umbo prominent, incurved anteriorly, situate about one-third the length of the shell from the anterior margin; lunule well defined cordate, much raised along the junction of the valves; shell anterior to the beak concave; anterior margin regularly convexedly rounded; post-dorsal margin at first gently sloping from

the beak backwards and downwards, practically straight, then roundly truncate to meet the very slightly convex ventral margin. The usual sized shell is ornamented with from 40 to 50 raised rounded narrow concentric ridges, which become lamellar anteriorly and posteriorly, interspaces very much narrower than the concentric ridges, becoming wider ventrally. The concentric ridges are so close as to prevent any radial ornamentation being seen at first, but, on holding the specimens with a strong light behind them, an exceedingly fine and close radial ribbing is just visible. Interiorly the shell margin is very minutely crenulated.

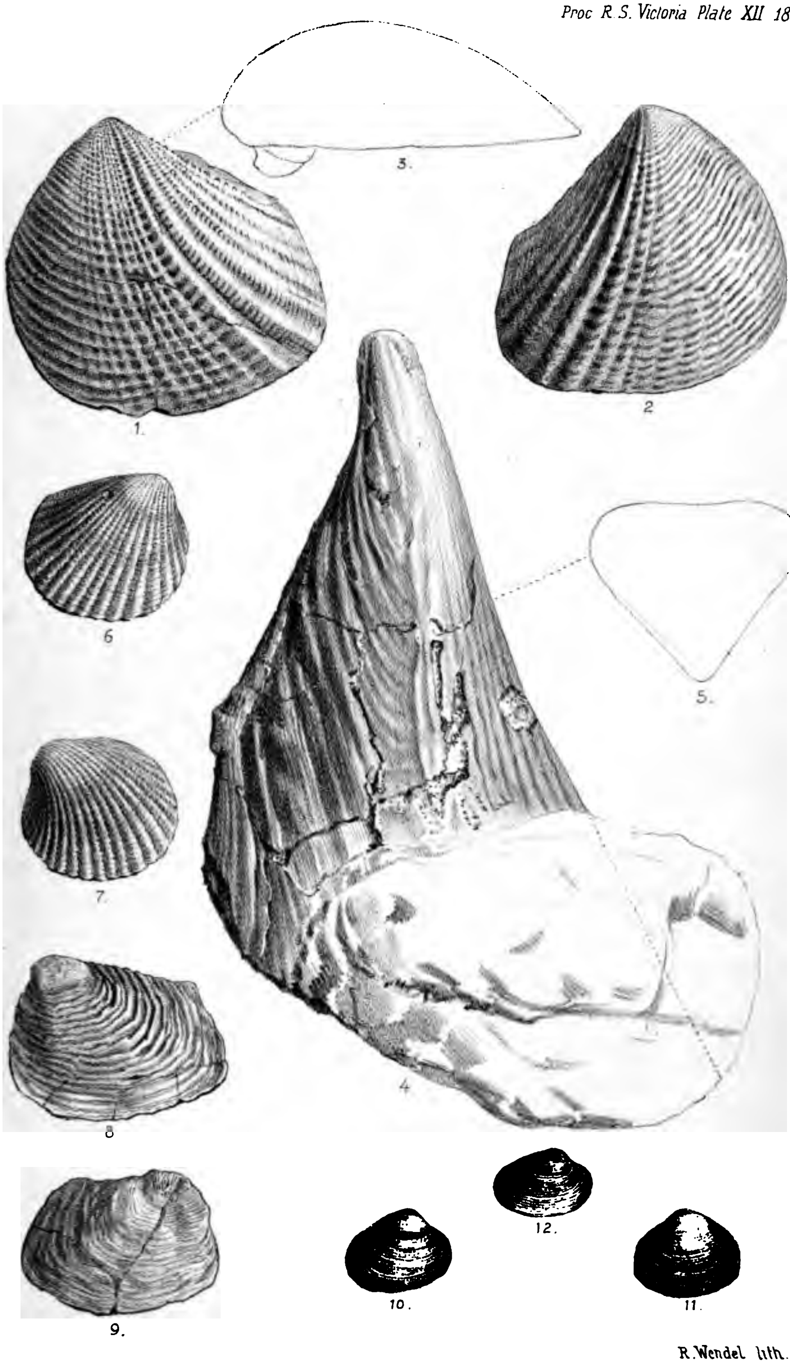
Dimensions.—Average specimens give the following measurements, antero-posterior diameter, 11·5 mm.; umbo-ventral diameter, 9 mm.; thickness through both valves, 6 mm. The largest specimen at present in my possession measures along its antero-posterior diameter, 16 mm., and umbo-ventral diameter, 13 mm.

Locality.—Common in the Lower Eocene sands and clays of Spring Creek, 14 miles south of Geelong.

Observations.—This species is very closely allied to *Chione propinqua*, T. Woods, but is a much smaller shell than the adult of that species; compared with young examples of *C. propinqua* of about the same size from the Miocene beds of Muddy Creek, the new species differs in form, is a thinner shell, is much more convex, the umbones are more prominent, the concentric ridges are finer and more numerous, the radial ribbing is obscure and is not continued on to the concentric ridges or lamellæ. These differences seem adequate to my mind to justify the proposal of a new specific name for this shell, particularly as they appeared very constant throughout my examination of upwards of sixty examples.

I have much pleasure in attaching to this shell the name of my friend, Mr. T. S. Hall, M.A., Demonstrator and Assistant-Lecturer in Biology at the Melbourne University.

In conclusion, I must express my indebtedness to Professor W. Baldwin Spencer, and tender to him my best thanks for photographing these shells for lithographic purposes.



R. Wendel lith.

EXPLANATION OF PLATE.

Fig. 1. Trigonia tatei, sp. nov., left valve, natural size.

Fig. 2. ,, ,, right valve, natural size.

Fig. 3. ,, ,, side view of a left valve, natural size.

Fig. 4. Pinna cordata, sp. nov., natural size.

Fig. 5. ,, ,, outline section at 3·5 cm. from apex.

Fig. 6. Cardita maudensis, sp. nov., right valve, twice natural size.

Fig. 7. Cardita maudensis, left valve, twice natural size.

Fig. 8. Myochama trapezia, sp. nov., left valve, natural size.

Fig. 9. ,, ,, right valve, natural size.

Fig. 10. Chione halli, sp. nov., right valve, natural size.

Fig. 11. ,, ,, left valve, natural size.

Fig. 12. ,, ,, right valve of a somewhat depressed form, natural size.

ART. XXIV.—*Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A., in the neighbourhood of Port Phillip Heads.*

PART I.

By ARTHUR DENDY, D.Sc.,

Professor of Biology in the Canterbury College, University of New Zealand; Corresponding Member of the Royal Society of Victoria.

[Read 13th December, 1894.]

INTRODUCTORY REMARKS.

In presenting the first part of this catalogue for publication it seems desirable to offer some prefatory remarks in explanation of the nature of the work. The circumstances under which the examination of Mr. Wilson's sponges was originally undertaken have already been explained in the introduction to the first part of my "Monograph of Victorian Sponges," and the reasons which led to the modification of the plan originally proposed, and to the at any rate temporary abandonment of the monograph as such, have been stated in the introductory remarks to my "Synopsis of the Australian Calcarea Heterocœla." I can hardly say that I regret having been obliged to modify my original plan. In the case of the Homocœla, dealt with in the first part of the monograph, the amount of material to be examined was comparatively small, and there was, consequently, a possibility of some approach to completeness in the first instance. In the other groups, however, the amount of material is so large that it certainly seems desirable to publish a systematic epitome without waiting for the possibility of publishing complete and final descriptions accompanied by the necessary illustrations. The Calcarea Heterocœla have thus already been dealt with, and I now enter upon the task of dealing similarly with the enormous mass of material comprised under the non-calcareous sponges.

The present catalogue makes no pretence to completeness. A very large number of small specimens as yet remain entirely

unexamined, and though the majority of these are doubtless duplicates, yet a certain proportion of new species will probably be found amongst them. The bulk of Mr. Wilson's collection of non-calcareous sponges is contained in upwards of nine hundred large Mason jars, each containing, as a rule, a single specimen, or at any rate so much of a specimen as could be got into the jar. All these have been microscopically examined, and will be included in the present catalogue. The specimens themselves are at present lodged in the Biological School of the Melbourne University.

The production of the catalogue has been unavoidably interfered with by my removal from Melbourne to Christchurch at the commencement of the present year. I wished, if possible, to complete the external examination of the specimens, and the preparation of rough microscopic sections of each before I left Melbourne, so as to avoid the necessity of removing the whole collection to New Zealand. This could not have been done had it not been for the great kindness of my friend, Mr. A. G. Fryett, who most generously offered his assistance, and devoted a month of continuous work to the cutting and mounting of the necessary sections. Meanwhile I drew up short descriptions of the external characters of each specimen and numbered each consecutively as it happened to come in the collection. I was thus able to bring to New Zealand sufficient data for the systematic working out of the collection. Before proceeding with this work, however, it was necessary to make a careful study of the numerous species described by Mr. H. J. Carter, F.R.S., from material sent to England some years ago by Mr. Wilson, and now lodged in the British Museum. Thanks to the kindness of Dr. Günther, F.R.S., keeper of the Zoological Department in the British Museum, I have in my possession fragments of a very large number of Mr. Carter's types, amounting to over 200 specimens of non-calcareous sponges, some dry and some in spirit. Of all these I prepared microscopical sections, and compared them with Mr. Carter's descriptions. I was thus able to gain an extensive personal knowledge of Mr. Carter's species, which will, I hope, add greatly to the value of the present work.

Amongst the collection in Melbourne I find that there are a very large number of duplicates, there being in some cases two or

three dozen jars of the same species. This is due to the fact that the species are very difficult to distinguish by external characters alone, owing to their variability in form and sometimes also in colour. Although the presence of so many duplicates has greatly increased the labour of examination, yet they are very valuable as showing the variation in form and colour. I have been very doubtful as to the advisability of enumerating every specimen in the present catalogue. As, however, they may be distributed amongst museums in various parts of the world and may thus be extremely useful as standards of reference, I have decided to do so.

Each specimen bears my own register number, prefixed by the letters *R.N.*, and quoted in this catalogue. After my own register number I have, except in cases where there are a large number of duplicates, quoted in brackets the particulars as to locality (station number or letter), and natural colour, supplied to me by Mr. Wilson. A number followed by the letter "f" indicates the approximate depth in fathoms.

I have also quoted under each species the specimens by which it is represented in the British Museum, so far as I have knowledge thereof. These specimens are numbered as sent out to me, the numbers being prefixed by the letters *B.M.* The letter "d" before any such number stands for "dry," and "sp." for "spirit." The name attached in the British Museum and the British Museum register number, where known, are quoted in brackets after the number. It is hoped that these precautions will facilitate any future discussion on questions of synonymy, and will indicate the exact nature of the authority on which I have relied.

As regards the exact locality in which the specimens were collected, I may mention that Mr. Wilson has arranged a series of dredging "stations" which he designates by means of letters or numbers. The letter "x" indicates a station outside but near Port Phillip Heads. A number prefixed simply by the letter "s" indicates a dredging station inside the Heads. I hope that Mr. Wilson may soon publish a list of these stations for convenience of reference.*

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* See Article XXV., in which Mr. Wilson has published the list of stations referred to.

As regards the notes on the colours of the living sponges supplied by Mr. Wilson, and forming a most valuable contribution to our knowledge of the group, I may remark that a large number of them are based upon a comparison of the specimens with the plates in Ridgway's "Nomenclature of Colors for Naturalists" (Boston, 1886), and that in these cases I have made use of the nomenclature of that author.

The present instalment, forming Part I. of the catalogue, includes only the Families Homorrhaphidæ and Heterorrhaphidæ of the Order Monaxonida. Although I am aware that considerable modification will doubtless have to be made in the classification of the Monaxonida as proposed by Mr. Ridley and myself in our "Challenger" Report, and that much valuable work in this direction has of late years been accomplished, especially by Mr. Topsent, yet I have decided to adhere for the present to our original scheme. I have done so because the "Challenger" Reports form an accessible and recognised standard of reference, and because the proposed modifications can hardly, in the present state of our knowledge, be considered as final. It may, however, be desirable to incorporate some minor and undoubted improvements at once, and in order to facilitate the work of the student I give diagnoses of the families, sub-families and genera as here employed. The spicular terminology is that of the "Challenger" Report on the Monaxonida.

The proportion of new species is, as might be expected from the extent of the collection, large. Thus, in the present contribution, out of a total of thirty-seven species seventeen are described as new.

The abbreviations made use of in the literature references will, I hope, explain themselves. The most frequent is "A.M.N.H.," which of course stands for "Annals and Magazine of Natural History."

Order MONAXONIDA.

Siliceous sponges with uniaxial megascleres.

Family HOMORRHAPHIDÆ.

Megascleres all diactinal, either oxea or strongyla; no microscleres.

Sub-family RENIERINÆ.

The spicules may be united together by a small proportion of horny matter, but are never completely enveloped in it.

Genus *Reniera* (Nardo).

Skeleton a close-meshed network of typically single spicules united together by their ends only. The spicules are short oxea or strongyla, whose length forms the width of the skeletal mesh, which may be rectangular, triangular or polygonal. Multispicular primary lines of spicules are often developed.

Reniera massalis, Carter, sp.

Thalysias massalis, Carter, A.M.N.H., January, 1886, p. 50.

This is a massive, compact, but rather friable sponge, with usually fair-sized and prominent vents. The skeleton is a moderately regular network of small oxea, arranged in slender multispiculary primary and unispicular secondary lines. The colour is pale yellow in spirit.

R.N. 349 (19 f; dirty white below, maroon-brown above); 429 (x, 19 f; coral red washed over raw sienna); 815; 1036 (x B).

B.M. d. 105 ("*Thalysias massalis*," Reg. 86-12-15-433).

Reniera brassicata, Carter, sp.

Phakellia brassicata, Carter, A.M.N.H., November, 1885, p. 363.

Reniera vasiformis, Carter, A.M.N.H., December, 1886, p. 445.

The sponge is stipitate, with vase-shaped head, which may be proliferous, the lamella being thin, or it may be simply flabellate. The rather stout and somewhat plumose primary lines of the skeleton are suggestive of an Axinellid affinity, the secondary lines are frequently unispicular and very irregular. I have only been able to examine Mr. Carter's "*Reniera vasiformis*," but his description leaves little doubt of the identity of this sponge with his "*Phakellia brassicata*." The oxea are of moderate size, rather stout, curved, fusiform and usually sharply pointed.

R.N. 187; 393; 533 (x, 19 f; "cadmium yellow"); ? 1099.

B.M. d. 101 ("*Reniera vasiformis*," Reg. 86-12-15-364).

Reniera clathrata, n. sp.

Sponge massive, spreading, irregular, somewhat clathrous and throwing off short, irregular, slender, anastomosing branches. Vents variable in size, mostly on monticular projections, either on the main body or on the branches. Texture soft, resilient, rather cavernous; very tender and friable. Light brownish-yellow in spirit.

Skeleton, a close network of small oxea, with small polygonal meshes commonly bounded by single spicules; loose multispicular primary lines may be distinguished in parts.

Spicules, short, fairly stout, fairly gradually sharp-pointed, slightly curved oxea, measuring about 0·083 by 0·005 mm.

This species may possibly be identical with some of the many British species described by Bowerbank under the name *Isodictya*, but I am not at present in a position to decide this question.

R.N. 920 (s.10); 1185.

Reniera longimanus, n. sp.

? *Chalina polychotoma*, pars., Coll. Brit. Mus.

Sponge compressed, thin, palmodigitate. Branches long, slender, compressed in the same plane. Vents minute, numerous, arranged in marginal rows. Surface smooth but minutely granular. Texture compact, firm, resilient, but easily breaking. Pale yellow in spirit.

Skeleton, a close, irregular network of small oxeote spicules, with multispicular primary and mostly unispicular secondary lines, but often very confused.

Spicules, short, slightly curved, fairly gradually sharp-pointed oxea, measuring about 0·083 by 0·005 mm. Except as regards the very characteristic external form this species closely resembles *R. clathrata*.

R.N. 576 (x, 19 f; "cream buff"); 609 (x, 20 f; "cream buff.")

? *B.M.* d. 68 ("*Chalina polychotoma*," Reg. 86-12-15-172).

Reniera proxima, n. sp.

Flabellate to palmo-digitate with short stout branches; may be stipitate with bushy palmodigitate head. Vents minute, numerous, scattered or marginal. Surface smooth. Texture

compact; but compressible and resilient, and not very tough. Pale yellow in spirit.

Skeleton, a close-meshed fairly regular network of small stout oxea; with well-marked, parallel, multispicular primary lines, three or four spicules thick, curving upwards and outwards and separated by the length of a spicule; secondary lines irregular, uni- or multispicular, usually joining the primaries at right angles.

Spicules, short, rather stout, slightly curved, rather bluntly pointed oxea, measuring about 0·16 by 0·012 mm. (R.N. 594, rather smaller in 1191).

This species is distinguished from *R. longimanus* chiefly by the size of the spicules.

R.N. 288 (18 f; "wax yellow"); 594 (x, 19 f; "cadmium yellow"); 1191.

Reniera fryetti, n. sp.

Erect; flabellate, but thick; slightly proliferous. Margin truncated, broad and flattened, covered with a finely porous membrane, beneath which the numerous long, ascending, main exhalant canals terminate. General surface subglabrous, minutely punctate, rather uneven. Texture compressible, resilient, rather soft and friable. Colour in spirit warm dark brown.

Skeleton, a close but irregular network of small oxea with meshes about one spicule's length wide; sometimes distinct multispicular primary lines may be distinguished.

Spicules, rather slender, slightly curved, fairly gradually sharp-pointed oxea, measuring about 0·12 by 0·005 mm.

This species is a very remarkable one, easily distinguished by the exhalant marginal pore-sieves and by the dark brown colour. I have very great pleasure in dedicating it to my friend, Mr. A. G. Fryett, as a slight recognition of his valuable aid in preparing microscopical preparations of the Victorian sponges.

R.N. 1141, 1183.

Genus *Halichondria*, Fleming.

Skeleton confused, may be fibrous, but never regularly reticulate. Spicules oxea or strongyla, usually long and slender. Spongin scarcely appreciable.

Halichondria cancellosa, Carter, sp.

Amorphina cancellosa, Carter, A.M.N.H., January, 1886, p. 50.

I have not met with any example of this species, nor have I been able to examine the original specimen. It seems to be a large, massive *Halichondria.* The dry sponge is light and fragile, with numerous vents scattered over the surface. The spicules are oxea, measuring about 0·3 by 0·0062 mm.

Halichondria arenacea, n. sp.

Massive, solid, with large collared vents on the convex upper surface and wide exhalant canals. Texture hard, friable and incompressible, owing to the immense quantity of coarse sand of which the interior is chiefly made up. The dermal membrane is free from sand in places, and then appears thin, delicate and minutely reticulate. Colour in spirit brown, owing to the sand.

Skeleton, consisting chiefly of the coarse sand grains irregularly and closely aggregated. Between the sand grains is a scanty, irregular spicular network, scarcely fibrous and almost Renierine in character.

Spicules, slender oxea, gently curved and fairly gradually sharp-pointed; measuring about 0·2 by 0·0045 mm.

R.N. 629 (x, 19 f; "lavender-grey").

Halichondria (?) nigrocutis, Carter, sp.

Amorphina nigrocutis, Carter, A.M.N.H., January, 1886, p. 50.

This is a massive irregular sponge, of a dark grey colour in spirit, which is due to the deeply pigmented, minutely reticulate dermal membrane. The main skeleton is composed of long, slender oxeote spicules scattered about in the utmost confusion, though sometimes collected into irregular fibrous tracts. There is a well differentiated dermal skeleton, consisting of a dense feltwork of much smaller oxea lying horizontally; it may become reticulate from the abundance of the inhalant pores. Numerous brown pigment cells are scattered throughout the sponge, especially towards the surface. It is difficult to believe that this sponge is not closely related to some of Mr. Carter's species of *Stellettinopsis*, but I can find no stellate microscleres. Sollas has already

suggested* that *Halichondria* may be derived from a *Stellettinopsis*-like ancestor by loss of the asters, and the characters of the present species certainly seem to strengthen this supposition.

R.N. 450 (s. 9, 17 f., "blackish slate"); 685 (s. 9); 727 (s. 5).

B.M. d. 102 ("*Amorphina nigrocutis*," unregistered).

Genus *Eumastia*, Schmidt.†

Sponge consisting of a massive body bearing elongated mammiform projections with vents at their apices. Skeleton consisting of long slender oxea, arranged irregularly or in loose fibres.

The genus resembles *Oceanapia* in external appearance, but differs in the large slender oxea, and probably also in the absence of the bast-like subdermal skeleton reticulation.

Eumastia schmidtii, n. sp.

The sponge consists of a hemispherical body, with long and short finger-like processes springing from its upper surface. Numerous minute vents occur at the summits of the larger fistulæ.

Skeleton, composed of thickly, but irregularly scattered oxea, sometimes collected into loose whisps and slightly projecting from the surface in loose tufts.

Spicules, long slender oxea, slightly curved and gradually sharp-pointed at each end; closely resembling those of a typical *Halichondria*; measuring about 0·4 by 0·008 mm.

R.N. 390.

Sub-family CHALININÆ.

A considerable amount of spongin is present, typically forming a thick sheath completely enveloping the spicules and uniting them into strong fibres. (In many species the spicules become greatly reduced in size and numbers, while the horny matter increases, thus forming a gradual transition to the so-called Horny sponges).

Genus *Pachychalina*, Schmidt.

External form various, but not tubular. Fibres stout, with spicules numerous and arranged polyserially.

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* Challenger Tetractinellida, p. 208.

† Grundzüge einer Spongien-Fauna des atlantischen Gebietes, p. 42.

Pachychalina aurantiaca, Lendenfeld, sp.?

? *Cladochalina aurantiaca*, Lendenfeld, Zoologischer Jahrbücher, vol ii., p. 768 (1887).

Sponge varying in form from compressed lamellar to digitate. Surface smooth, with minutely reticulate dermal membrane. Vents small, numerous; irregularly scattered, marginal or confined to one side. Texture soft, resilient. Colour in spirit pale yellow.

Skeleton, rather wide-meshed, with stout main fibres curving outwards from the centre to the surface, and densely packed with numerous small oxea; these are rather sparingly connected by slenderer secondary fibres which run approximately at right angles to them, and are also multispicular. Immense numbers of spicules are also scattered in the soft tissues between the fibres. There is a well-marked dermal skeleton composed chiefly of close-set tufts of spicules arranged perpendicular to the surface and forming a close-meshed polygonal network when viewed from the exterior.

Spicules, small, slender oxea; gently curved, and gradually sharp-pointed; measuring about 0·14 by 0·004 mm.

Von Lendenfeld's type is stated to come from Port Phillip, so that in spite of the meagreness of his description the identification seems fairly likely to be correct, although the spicular measurements differ slightly.

R.N. 410 (x, 19 f; "ochre yellow"); 753 (s. 5, "ochre buff"); 823 (x).

Pachychalina claviformis, Carter, sp.

Acervochalina claviformis, Carter, A.M.N.H., November, 1886, p. 376.

I have only seen a fragment of one of Mr. Carter's specimens from the British Museum; the species appears to be rare. It is characterised by its erect, cylindrical or pear-shaped form, with discoid, root-like attachment below. The surface is smooth; the vents numerous and large; the texture very loose and tender. The skeleton is a very sparse and irregular network of ill-defined, slender, partly multispicular and partly unispicular fibres. The spicules are slightly curved, gradually sharp-pointed oxea, measuring about 0·17 by 0·006 mm.

B.M. sp. 32 ("*Acervochalina claviformis*" Reg. 86-12-15-50).

Pachychalina tenella, Lendenfeld, sp.

Chalinopora tenella, Lendenfeld, Zoologischer Jahrbücher, vol. ii., p. 765 (1887).

The sponge is irregularly massive, sessile, with prominent vents and smooth but uneven surface. The texture in spirit is very soft, spongy and tender, and the colour pale yellow.

Skeleton, a lax and very irregular network of slender, usually multispicular fibres, with numerous spicules scattered between.

Spicules, very slender, slightly curved, gradually sharp-pointed oxea, measuring about 0·1 by 0·0027 mm.

Von Lendenfeld's type also comes from Port Phillip, where the species is common.

R.N. 660; 733 (x, B; "cream buff"); 755 (s. 5; "wax yellow"); 756 (s. 5; "wax yellow"); 767 (Sorrento Jetty; "wax yellow"); 774 (Sorrento Jetty; "sponge grey"*); 783 (Sorrento Jetty, "wax yellow").

Pachychalina bilamellata, (Lamarck ?) Carter, sp.

Cavochalina bilamellata, Carter, A.M.N.H., October, 1885, p. 287.

Placochalina pedunculata, Lendenfeld, Cat. Spong. Aust. Mus., p. 90.

This remarkable sponge usually has a very characteristic external appearance, being leathery and thinly flabellate, and often growing out into two wing-like expansions from a common peduncle. The skeleton network is close-meshed, with multispicular fibres and many spicules scattered between; the meshes vary from quite irregular in the interior to rectangular towards the surface. The spicules are short oxea, measuring about 0·54 by 0·004 mm.

R.N. 741 (x, B; "sponge grey"); 1008 (x B); 1143 (x).

B.M. d. 73 ("*Cavochalina bilamellata*," Reg. 86-12-15-186).

Genus *Chalina*, Grant.

Form various, not tubular. Skeleton reticulation rectangular, with much spongin and few spicules.

* The grey tint is due to the presence of foreign matter in the form of immense numbers of parasitic worms, crustacea, etc.

Chalina polychotoma, (Esper?) Carter.

Chalina polychotoma var. *trichotoma*, Carter, A.M.N.H., February, 1885, p. 115.

Chalina polychotoma (with varieties *trichotoma*, *compressa*, *oculata*, *robusta*, *angulata*, *moniliformis)*, Carter, A.M.N.H., October, 1885, pp. 284, 285.

This common species appears to be extremely variable. It is usually a large sponge divided into long, slender or robust branches of very varying shape, and bearing small, scattered or serial vents. The texture is compressible and resilient, and the colour in spirit yellow or brown. In life the prevailing colour is also brown. The skeleton is a close, more or less rectangular-meshed network of horny fibre, more or less abundantly cored with small slender oxea, which may also be scattered between the fibres. The spicules vary somewhat in size, but are usually about 0·06 mm. long.

Mr. Carter has distinguished a number of form varieties, but it is very doubtful whether these can be maintained.

As the specimens collected by Mr. Wilson are so numerous I refrain from giving the locality and colour of each individually. Nearly all of which the locality is recorded come from outside the Heads; one, however, is recorded from Station 9, and one from Sorrento Jetty. The recorded colours range from some shade of brown to "cinnamon-rufous" and "heliotrope-purple."

R.N. 263; 270; 313; 325; 328; 330; 414; 469; 596; 724; 786; 873; 1016; 1022; 1032; 1040; 1081 (these are all more or less ordinary forms); 523 (compressed and flabellate, with finger-like processes); 639; 640; 669; 1007 (these have the numerous spicules in the primary fibres arranged in a markedly plumose fashion, as in *Axinellidæ*); 1018 (the arrangement of the spicules is very Renieroid, but they are completely imbedded in spongin).

B.M. d. 63 ("var. *nigra*" M.S. Reg. 86-12-15-165); d. 64 ("var. *robusta*" Reg. 86-12-15-163); d. 65 ("var. *oculata*" Reg. 86-12-15-154-155); d. 71 ("var. *angulata*" Reg. 86-12-15-168); d. 72 ("var. *compressa*" Reg. 86-12-15-159).

Chalina viridis, n. sp.

Sponge composed of slender, irregular, cylindrical or sub-cylindrical branches, with smooth surface and numerous small vents which may be scattered or serial. Texture (in spirit) compressible and resilient. Colour (in spirit) dark brown; when alive dark green.

Skeleton, a network of rather slender horny fibres cored with slender oxea, and sometimes with numerous spicules scattered between the fibres in the soft tissue. The entire skeleton is frequently interrupted by the large canals, which give a very characteristic mottled appearance to sections. Between these interruptions the skeleton net is close-meshed. Towards the surface the meshes are sub-rectangular and little more than one spicule's length in width; in the interior of the sponge they are very irregular. The primary fibres at first run longitudinally in the central portion of the sponge, and branching dendritically curve outwards to the surface; they are multispicular and about 0·02 mm. thick. The secondary, connecting fibres are nearly as thick but mostly unispicular.

The dermal skeleton is a close network with polygonal meshes, formed by fibres resembling the secondaries of the main skeleton.

Spicules, short, straight (or slightly curved), slender oxea, gradually sharp-pointed at each end; measuring when full sized about 0·058 by 0·0028 mm.

Spirit specimens of this sponge are very insignificant looking, but the dark green colour in life, changing to dark brown in spirit, appears to be characteristic. As regards skeletal characters I do not think that the species could be distinguished from *Chalina polychotoma*, of which perhaps it is only a variety.

R.N. 333 (18 f; "dark rifle green"); 572 (x, 19 f; "parrot green"); 744 (x, B; "rifle green").

Chalina pergamentacea, Ridley, sp.

Chalina pergamentacea, Ridley and Dendy, Challenger Monaxonida, p. 27 (previous references given here).

Ceraochalina papillata, Lendenfeld, Zoologischer Jahrbücher, vol. ii., p. 779 (1887).

The sponge is broadly digitate, often compressed, with scattered or serial vents and glabrous or subglabrous dermal membrane. It is very compressible and of a translucent yellow colour in spirit. The horny fibres are stout and well-developed, but the spicules are reduced to hair-like thinness, scattered more or less abundantly in and between the stout fibres. This great reduction of the spicules and the strong development of the spongin form the most characteristic features of the species.

R.N. 453 (s. 9, 20 f; "vinaceous cinnamon"); 461 (s. 14, 10 f; "smoke grey"); 657 (x, 20 f; "wood brown with wash of yellow"); 807 (s. 5); 855 (s. 9); 875 (s. 9); 906 (s. 8).

Genus *Siphonochalina* (Schmidt).

Sponge tubular; tubes smooth, both inside and out, usually narrow, each with a large round opening (pseudosculum or vent) at the summit.

Siphonochalina procumbens, Carter, sp.

Patuloscula procumbens, Carter, A.M.N.H., May, 1882, p. 365.

Patuloscula procumbens, Carter, A.M.N.H., October, 1885, p. 286.

Siphonochalina procumbens, Dendy, Trans. Zool. Soc., vol. xii. p. 355., pl. lviii., fig. 4; pl. lxii., fig. 1.

In my memoir on the "West Indian Chalininæ" (*loc. cit.*) I questioned Mr. Carter's indentification of the Victorian species with his own West Indian *Patuloscula procumbens.* Having carefully reconsidered the question I do not think it desirable to separate the two.

The sponge is composed of a number of short wide tubes fused together laterally, and each bearing a wide vent at the summit. The surface is uneven but smooth; the texture tough and resilient; the colour in spirit pale yellowish-brown. Perhaps the most characteristic feature is afforded by the remarkably short, nearly straight, hastately pointed oxea, measuring about 0·07 by 0·005 mm. Mr. Carter gives the colour in life as "purple-slate."

R.N. 1150 (x).

B.M. d. 76 ("*Patuloscula procumbens.*" South coast of Australia. Reg. 86-12-15-208).

Siphonochalina procumbens, var. *flabelliformis*, Carter. var.

Patuloscula procumbens, var. *flabelliformis*, Carter, A.M.N.H., October, 1885, p. 286.

I have only seen a fragment of Mr. Carter's specimen of this variety. He describes the sponge as consisting of greatly elongated tubes united laterally into a fan-shaped form, rising from a single stem. The skeletal differences as compared with the typical form are very slight.

B.M. d. 78 (“*Patuloscula procumbens*, var. *flabelliformis*. Reg. 86-12-15-203).

Siphonochalina bispiculata, n. sp.

Sponge irregular, sublamellar, low-growing, proliferous; sometimes rising into short, tubular digitations, each with a wide vent at the summit, or the vents may be smaller and marginal. In spirit the texture is compressible and resilient, and the colour pale yellow.

Skeleton, an irregular or rectangularly meshed network of stout horny fibre containing few spicules. The primary fibres measure about 0·05 mm. in diameter, and the secondaries little less. The primary fibres contain a few rather long oxea, the secondaries usually contain no spicules at all, or a very few of the short oxea, which sometimes project from them at right angles. A few spicules occur scattered in the soft tissues, and there is a well-developed dermal skeleton composed of radiating tufts of long slender oxea.

Spicules, the oxea are of two distinct kinds:—*(a)* long and slender, straight, gradually sharp-pointed, measuring about 0·2 by 0·004 mm.; *(b)* extremely short, relatively stout, hastately spindle-shaped spicules, with sharp points; measuring about 0·035 by 0·004 mm.

The long oxea occur abundantly in the dermal tufts, and scattered through the soft tissues of the interior. The short ones occur sparsely scattered through the soft tissues, and irregularly in, and projecting from, the horny fibres. Intermediate forms occur in the primary fibres.

In external appearance this species resembles *Siphonochalina procumbens*, but its remarkable spiculation separates it from all

other Chalininæ with which I am acquainted. Both specimens contain numerous developing embryos and come from the same station, so that they may possibly be parts of one and the same sponge.

R.N. 1055 (x A); 1079 (x A).

Family HETERORRHAPHIDÆ.

Skeleton reticulate, never plumose. Megascleres of various forms. Microscleres usually present, but never chelæ.

Genus *Gellius*, Gray.

Sponge without rind or fistulæ. Megascleres all diactinal, oxea or strongyla. Microscleres present in the form of sigmata, toxa or trichodragmata. Very little spongin present, never forming distinct fibres.

Gellius phillipensis, n. sp.

Massive or encrusting, with smooth but uneven surface and prominent vents. In spirit the texture is spongy, resilient and friable, and the colour white or yellowish.

Skeleton, the main skeleton is a close-meshed network of spicules with little or no spongin, the arrangement being between Renieroid and Halichondrioid. The dermal skeleton is a close-meshed reticulation of spicular fibre echinated by abundant tufts of oxea projecting at right angles to the surface.

Megascleres, rather slender, slightly curved oxea; usually gradually sharp-pointed and measuring about 0·18 by 0·0055 mm.

Microscleres, *(a)* very numerous, very slender sigmata, varying greatly in length, simple and contort. *(b)* trichodragmata; bundles of hair-like spicules varying much in length in different bundles.

In the presence of trichodragmata this species resembles Carter's *Fibularia massa*,* which is a *Gellius* from Nassau.

R.N. 334 (7 f; "wax yellow"); 702 (s. 5; "brownish-yellow"); 723 (s. 5); 973 (s. 5); 794 (variety ?).

* A.M.N.H., April, 1882, p. 282.

Genus *Gelliodes*, Ridley.

Megascleres diactinal, oxea or strongyla. Microscleres sigmata. With a distinct skeleton fibre containing more or less spongin.

Gelliodes poculum, Ridley and Dendy.

Gelliodes poculum, Ridley and Dendy, Challenger Monaxonida, p. 48, pl. x.

I refer one of Mr. Wilson's specimens to this species with a little hesitation. The specimen is erect and goblet-shaped, with broad base, and contains much foreign matter. The oxea are a good deal slenderer than in the type, and the whole skeleton is very irregular.

R.N. 448 (s. 14; 10 f; "mouse grey").

Genus *Oceanapia*, Norman.

Sponge consisting of a central body with closed or open tubular processes (fistulæ) projecting from it. Megascleres oxea or strongyla. Microscleres in the form of sigmata, or altogether absent. Skeleton usually coarsely spiculo-fibrous; with a bast-like reticulation beneath the dermal membrane.

As suggested in our work on the Challenger Monaxonida, it seems desirable to unite the genera *Oceanapia* and *Rhizochalina* in one, and as Norman's name has precedence it must of course be employed.

Oceanapia mollis, n. sp.

Massive, irregular; with numerous large, prominent, collared vents, rising up from the general surface and leading out of great exhalant canals. Surface uneven, sometimes ridged, sub-glabrous, minutely reticulate, with a few extremely small and insignificant-looking, closed fistulæ, not at all comparing with the oscular projections in size. Texture soft, compressible, resilient, fragile. Colour in spirit pale brownish-yellow.

Skeleton, the main skeleton is a loose and almost unispicular reticulation of fairly stout oxea, connected chiefly at their ends by a fair amount of spongin. The dermal skeleton consists of a superficial network of single spicules, more or less crossing one another, and beneath this a thin bast-like layer composed of a wide-meshed network of multispicular but rather slender fibres.

Megascleres, fairly stout, slightly curved, gradually sharp-pointed oxea, measuring about 0·2 by 0·0083 mm. In the deeper parts numerous very slender oxea occur between the others, of which they are probably young forms.

Microscleres, very numerous, short and very slender, C-shaped sigmata, measuring about 0·016 mm. from bend to bend.

This sponge is especially characterised by the very feeble development of the closed fistulæ, so that it makes a near approach to the genus *Gellius*, in which they are entirely absent. Both specimens were received at the same time, and though in separate jars, they are probably parts of the same individual.

R.N. 1167 ; 1193.

Oceanapia imperfecta, n. sp.

This species is represented in the collection by a squarish chunk evidently cut from the upper part of a large massive specimen. The upper surface is flattened, subglabrous, and very minutely reticulate. It bears numerous very small, thimble-shaped, blind fistulæ, with reticulate walls and only about one-fifth of an inch high. Numerous long canals run up and terminate in these fistulæ. The texture of the whole sponge is very soft, spongy and tender. The colour in spirit is very pale yellow.

Skeleton, the main skeleton is a loose network of very distinct spicular fibres, each about 0·055 mm. in diameter, and composed of densely packed spicules with little or no spongin. The dermal skeleton is an irregular, close-meshed, bast-like network of spicule bundles, abundantly echinated by close-set tufts of projecting oxea.

Megascleres, long, slender and almost straight oxea, cylindrical and hastately pointed at each end; measuring about 0·25 by 0·006 mm.

I have not been able to find any microscleres.

R.N. 1181.

Oceanapia phillipensis, n. sp.

The sponge consists of a massive, sessile, depressed body, coated and charged with foreign matter, and sending up a number of elongated, hollow fistulæ, ranging up to about three inches in

length and one-third of an inch in diameter. These processes may either end blindly and bluntly, or bear small vents at the summit. The body is fairly compact but compressible and rather spongy, and nearly white in spirit.

Skeleton, in the interior of the body no fibres appear to be developed, and the skeleton consists of loosely but very thickly scattered spicules. The dermal skeleton of the body is obscured by the foreign matter. In the fistulæ we have the usual bast-like, reticulate dermal skeleton, strongly echinated by projecting tufts of oxea. Beneath this the cavity of the fistula is partly blocked up by an irregular, close-meshed network of very stout spicular fibre. Towards the surface the meshes became very small and sub-rectangular in shape.

Megascleres, rather short, slightly curved, hastately sharp-pointed oxea, measuring about 0·12 by 0·005 mm.

I have seen no microscleres.

R.N. 321 (18 f; "body pale buff-brown. Projections white"); 1184.

Oceanapia cohærens, Carter, sp.

Phlœodictyon cohærens, Carter, A.M.N.H., December, 1886, p. 446.

My personal acquaintance with this species is limited to a piece of the original specimen sent to Mr. Carter. This specimen was a cylindrical fragment made up of some twenty united tubes terminating in as many vents, all lying close together at the truncated end of the sponge. The skeleton is arranged as usual in the genus, with bast-like dermal network, and coarse, stout spicular fibres in the interior. The spicules are curved oxea, abruptly and bluntly pointed, measuring about 0·15 by 0·008 mm.

B.M. sp. 34 ("*Phlœodictyon cohærens*," Reg. 87-7-11-13).

Genus *Chondropsis* (Carter), n. gen.

Skeleton composed largely of sand and other foreign bodies, usually (? always) arranged in distinct fibres or columns. Spicular skeleton greatly reduced. Megascleres diactinal, strongyla or tylota. Microscleres nearly always present in the form of sigmata.

I had intended using von Lendenfeld's name *Sigmatella* for this genus, but found from Scudder's "Nomenclator Zoologicus" that it was already occupied.

The genus is here employed in a somewhat more restricted sense, however, than was intended by von Lendenfeld for *Sigmatella.* That author's diagnoses* make no sharp distinction between Marshall's *Phoriospongia* and his own *Sigmatella.* If, however, we restrict *Phoriospongia* to species with monactinal megascleres, as was done by Marshall, and reserve *Chondropsis* for those with diactinal megascleres, we shall have a very natural distinction. The occasional styli observed by von Lendenfeld in species of his *Sigmatella*, and by Carter in *Chondropsis*, were probably abnormal or accidental; in all cases the diactinal spicules predominate.

Unfortunately, Carter's type species of *Chondropsis* (*C. arenifera*) is not a good example of the genus, being devoid of the characteristic sigmata. He gives† no diagnosis, however, and terms his group "Chondropsina," which is co-extensive with his one species, "provisional." The genus *Chondropsis* may, therefore, be really considered as a new one, now for the first time defined.

I have very good evidence of an Ectyonine origin for this genus, but have not space to enter into the question here.

Chondropsis kirkii, Carter, sp.

Dysidea kirkii, Carter, A.M.N.H., March, 1885, p. 216.

(?) *Sigmatella australis*, Lendenfeld, Monograph of Horny Sponges, p. 611.

Sigmatella corticata, Lendenfeld, Monograph of Horny Sponges, p. 618.

The sponge is massive, often compressed but thick, sometimes digitate. The vents are usually large and conspicuous. The surface is smooth or minutely conulose and usually finely reticulate. The texture is compressible, and the colour in spirit pale grey.

The main skeleton is a very beautiful, irregular, tracery-like network of very fine-grained sand-fibre. There is a close-meshed dermal network of similar sandy fibre. The spicular elements are greatly reduced, though the megascleres may still be observed in radiating tufts towards the surface.

* Monograph of Horny Sponges, pp. 598, 611.

† A.M.N.H., February, 1886, p. 122.

The megascleres are very slender strongyla, and the microscleres very minute, much curved, simple and contort sigmata, usually extremely abundant.

This is an exceedingly common sponge, there being no less than thirty-nine specimens in Mr. Wilson's collection; the stations recorded being 5, 6, 7, 8, 9, 10, 11, 14, x A, x B, and Sorrento Jetty. The natural colours of eighteen specimens are recorded; most are shades of yellow or orange; three are pink or salmon; a few are grey with violet or purple tints, and one is bright red.

In two of the British Museum specimens I have found abundant rods and sigmata, as described by von Lendenfeld; in the other (d. 2) I have found rods only. In one of Mr. Wilson's later specimens I have also failed to find sigmata (R.N. 1031).

B.M. d. 2 ("*Dysidea kirkii*," Reg. 86-12-15-333); d. 5 ("*Dysidea kirkii*, var. *flabelliformis*," Reg. 86-12-15-344); d. 6 ("*Dysidea kirkii*," Reg. 86-12-15-323).

R.N. 309; 318; 336; 456; 457; 458; 515; 688; 703; 704; 714; 765; 766; 771; 775; 777; 785; 788; 795; 816; 831; 832; 854; 859; 864; 883; 894; 908; 943; 954; 985; 993; 1030; 1031; 1053; 1059; 1060; 1094; 1198.

Chondropsis wilsoni, n. sp.

Massive, lobose, or irregular; sometimes compressed, but thick. Vents of moderate size, scattered on prominent parts. Surface rugose or warty, but glabrous and with minutely reticulate dermal membrane between the projections. On the prominent parts of the surface small scar-like sandy areas are scattered, but there is no sandy dermal reticulation. Texture tough, very sandy internally but rather soft and compressible. Colour in spirit nearly white.

Skeleton, stout columns of comparatively coarse sand, more or less widely separated from one another, run vertically to the surface, where they terminate in the scar-like sandy areas already mentioned. The sand grains are cemented together by spongin, and stout clear horny fibres occasionally run across from one sandy column to another. Between the sandy columns loose whisps of megascleres, often more or less enveloped in spongin, run towards the surface. The only dermal skeleton is formed by the loose tufts in which these whisps terminate.

Megascleres, almost straight, very slender strongyla or tylota with irregular heads, measuring about 0·18 by 0·0025 mm.

Microscleres, slender C-shaped sigmata of very regular form and bluntly pointed or even slightly swollen at the extremities, measuring about 0·016 mm. from bend to bend. The surface of the spicule may be very finely roughened.

R.N. 540 (x, 19 f; "buff"); 613 (s. 5, 7 f; "ochre-yellow"); 658; 735 (x B; "yellowish buff with reddish tips"); 817; 1054 (x A); (? *R.N.* 663; 711).

Chondropsis lamella, Lendenfeld, sp.

Phoriospongia lamella, Lendenfeld, Monograph of Horny Sponges, p. 602. Plate 37; figs. 2, 5, 6, 9, 11.

These are compressed, flabellate sponges, with sub-glabrous, sometimes slightly conulose surface, and small, scattered or marginal vents. They are intensely sandy throughout, incompressible and friable. The megascleres are very few slender strongyla; the microscleres are sigmata, characteristically long, slender and much contorted.

R.N. 520 (x, 20 f; "ferruginous"); 1019 (x B).

Chondropsis chaliniformis, Lendenfeld, sp.

Phoriospongia chaliniformis, Lendenfeld, Monograph of Horny Sponges, p. 600.

The specimens are compressed, flabellate or palmo-digitate, with vents scattered on one. side or marginal. The surface is subglabrous with sandy reticulation showing through the thin dermal membrane. Texture slightly compressible, very sandy, friable. Colour in spirit very characteristic, chocolate-brown throughout, the colouring matter pervading all the soft tissues.

The main skeleton is an irregular network of coarse sandy fibre, the sand particles being comparatively large, and the spongin cement very scanty. There is no special dermal skeleton. The spicular elements are very insignificant, and loosely scattered in the soft tissues.

Megascleres, very slender, straight or curved strongyla, or tylota with feebly developed heads, measuring about 0·14 by 0·0014 mm.

Microscleres, numerous slender, contort sigmata, measuring about 0·03 mm. from bend to bend.

The sandy skeleton appears to be somewhat coarser, and the sigmata decidedly smaller than described by von Lendenfeld, but not sufficiently so to invalidate an identification. The sponge, however, appears to be quite distinct from Carter's "*Dysidea chaliniformis*," with which von Lendenfeld identifies it. My preparation of Carter's specimen from the British Museum shows it to belong to the *Esperellinæ*.

R.N. 945 (x A); 1027 (x B); 1044 (x); 1083 (x A).

Chondropsis columnifer, n. sp.

Massive, irregular, solid, heavy, compact. Surface very uneven, beset with short, flattened, rounded or ridge-like prominences, where the sandy columns come to the surface; smooth, glabrous and grey (in spirit) between these projections. Interior densely charged with sand, arranged in very stout radiating columns; soft and gelatinous between.

Skeleton, the main skeleton is composed of the very stout columns of sand above-mentioned, in which the sand-grains, though closely aggregated, appear to be scarcely if at all connected by spongin. The few and feebly developed spicules are irregularly scattered or collected into loose whisp-like bundles, especially towards the surface. There is no dermal skeleton.

Megascleres, very slender, straight strongyla or tylota, measuring about 0·2 by 0·002 mm.

Microscleres, fairly stout, contort, sharp-pointed sigmata, measuring about 0·035 mm. from bend to bend.

R.N. 445 (s. 9, 17 f; "gallstone yellow over wood-brown").

Chondropsis topsentii, n. sp.

Massive, irregular, with nearly smooth but slightly conulose or mæandriniform surface. Vents of fair size, scattered. Texture compact, gritty, friable, densely charged with coarse sand. Colour in spirit brown throughout.

Skeleton, the main skeleton is composed of flattened columns of rather coarse sand running vertically to the surface. These columns may unite by their edges in a honeycomb fashion, so

that their ends form a polygonal-meshed reticulation beneath the dermal membrane. The meshes of this reticulation are about 1·3 mm. in diameter and the plate-like sandy columns about 0·2 mm. in thickness. Little if any spongin cement is developed. Between the sandy plates in the body of the sponge the foreign bodies are few and small, but in the minutely reticulate, porous dermal membrane numerous small foreign bodies occur scattered irregularly.

Megascleres, few, slender strongyla, perhaps sometimes tylota; sparsely scattered through the ground substance and sometimes more abundant in loose tufts at the surface; measuring about 0·14 by 0·002 mm.

I can find no proper microscleres in any of the three specimens.

R.N. 487 (s. 10, 8 f; "drab-grey"); 499 (s. 6, 6 f; "clove-brown with a faint wash of green"); 1071 (x A).

Chondropsis arenifera, Carter.

Chondropsis arenifera, Carter, A.M.N.H., February, 1886, p. 122.

The single entire specimen which I have examined is massive, rounded, and irregular; with smooth, very minutely reticulate and faintly conulose surface, and large, scattered vents. The texture (in spirit) is rather soft and resilient, sandy, and the colour grey throughout.

The main skeleton consists of very loose and irregular sandy fibres (with little or no spongin), running vertically to the surface. The beautifully reticulate, highly porous dermal membrane contains numerous small, scattered foreign bodies, but there is no distinct dermal skeleton.

The proper spicules are slender strongyla or tylota, scattered through the ground substance, and more numerous in loose tufts at the surface. They measure about 0·16 by 0·002 mm. Numerous other spicules occur as foreign bodies. There appear to be no proper microscleres.

Although Carter mentions proper styli as occurring in this species, I cannot find them in the fragment of his specimen sent to me from the British Museum. My own specimen (R.N. 454), agrees exactly with the type in microscopical features, even down to the presence of the Algæ mentioned by Carter.

R.N. 454 (s. 9, 20 f; "olive grey.")

B.M. sp. 26 ("*Chondropsis arenifera* C. one of types." Reg. 86-12-15-149).

Chondropsis carteri, n. sp.

The single specimen is small, massive, rounded, constricted below and somewhat flattened above. The vents are minute and grouped on the upper part. The surface is smooth but rather uneven, minutely reticulate in patches. The texture in spirit is compact, but rather compressible, resilient, and the colour pale yellowish-grey.

The main skeleton consists of numerous stout sandy tracts or fibres running more or less parallel with one another towards the surface, and varying greatly in thickness and definition. These sandy fibres are accompanied by numerous strongyla, and occasionally connected transversely by loose bands of the same distinctly enveloped in spongin. The strongyla also occur abundantly scattered through the ground substance, and in loose whisp-like tracts running towards the surface. There is a soft dermal cortex, a little more than a millimetre thick, beneath which the sandy fibres cease. This cortex contains numerous, rather regularly disposed, slender, radiating tufts of strongyla, and numerous loosely scattered sand grains.

Megascleres, very numerous, straight, slender strongyla, measuring about 0·23 by 0·003 mm.

Microscleres, abundant, rather long, hair-like rhaphides; scattered and in loose whisp-like bundles (trichodragmata).

R.N. 978 (s. 5.)

Genus *Rhaphisia*, Topsent.*

Heterorrhaphidæ with oxea for megascleres and only trichodragmata or scattered rhaphides for microscleres.

I accept the genus as proposed by Topsent, but I cannot agree with that author in placing it amongst the *Renierinæ*.

Rhaphisia anonyma, Carter, sp.

Amorphina anonyma, Carter, A.M.N.H., January, 1886, p. 49.

Massive, lobose or irregular, often compressed; with usually large vents abundant on prominent parts. The surface is smooth

* Arch. de Zool. Exp. et Gén. T. x. 1892, p. 20.

but uneven, with minutely reticulate dermal membrane. The texture is soft, compressible, resilient and loose. The colour in spirit is almost white, in life, usually orange.

The skeleton is loosely fibrous, forming a very irregular network, the primary fibres being stouter and better defined than the secondaries. There appears to be little, if any, spongin. At the surface the primary fibres break up into radiating tufts of oxea which support the dermal membrane and give rise to the characteristic dermal reticulation. Numerous spicules are scattered between the ill-defined fibres.

Megascleres, slightly curved oxea, rather long and slender and gradually sharp-pointed at each end, measuring about 0·29 by 0·0042 mm.

Microscleres, numerous slender, hair-like rhaphides, about 0·18 mm. long; usually scattered separately but occasionally associated in loose whisps or bundles (trichodragmata).

Mr. Carter seems to have rather over-stated the size of the oxea and he has omitted to mention the rhaphides, which are plentiful in his specimens in the British Museum.

The species is very common, there being no less than twenty-four distinct specimens in the collection entrusted to me. The life-colours of thirteen of these are recorded. Orange is the prevailing tint and there are no great deviations from this. The stations from which the species is recorded are 1, 5, 6, 14, x A, x B, x C.

R.N. 268; 369; 395; 447; 482; 544; 553; 577; 631; 651; 699; 706; 751; 804; 818; 909; 914; 936; 957; 1066; 1067; 1085; 1110; 348 (var. ?).

B.M. sp. 30 ("*Amorphina anonyma*," Reg. 86-12-15-119); d. 104 ("*Amorphina anonyma*," Reg. 86-12-15-390).

Genus *Tedania*, Gray.

Megascleres of two kinds: (1) Monactinal; smooth styli, forming the main skeleton; (2) Diactinal; tylota, strongyla or tornota, typically dermal. Microscleres always present in the form of hair-like rhaphides.

Tedania digitata, Schmidt, sp.

Reniera digitata, Schmidt, Spong. Adriat. Meer., p. 75.

Tedania digitata, Carter, A.M.N.H., January, 1886, p. 52.

Tedania digitata, var. *verrucosa*, Carter, A.M.N.H., January, 1886, p. 53.

Tedania digitata, Ridley and Dendy, Challenger Monaxonida, p. 51 (where other references are given).

This widely distibuted species is very common in the neighbourhood of Port Phillip Heads, there being no less than thirty-four separate specimens in the collection. The external form is massive, lobose or digitate; the vents usually conspicuous, small or large; the surface smooth but generally uneven; the texture soft and spongy; the colour in spirit nearly white, and in life orange. In all of the thirty-four specimens the ends of the diactinal megascleres are microspined, a character by which the species is readily distinguished from the following one.

The life-colours of fifteen specimens are recorded, ten of these are stated to be some shade of orange, four are some shade of yellow, and one is "buff-brown with a tinge of flesh-colour," so that the variation is seen to be but slight.

The stations recorded are 1, 3, 5, 6, 8, 9, 10, x A, x C, Sorrento Jetty, Sorrento Reef, Queenscliff Jetty. Nine specimens came from Sorrento Jetty.

R.N. 320; 455; 526; 563; 568; 569; 692; 715; 720; 764; 770; 776; 780; 782; 784; 786A; 789; 796; 802; 814; 834; 850; 866; 871; 892; 962; 971; 975; 991; 992; 1069; 1093; 1105; 1106.

B.M. d. 109 ("*Tedania digitata*," Reg. 86-12-15-439); d. 110 ("*Tedania digitata*, var. *verrucosa*, Reg. 86-12-15-432).

Tedania commixta, Ridley and Dendy.

Tedania commixta, Ridley and Dendy, Challenger Monaxonida, p. 52, pl. xxiii., fig. 9.

This species was represented by a single specimen in the Challenger collection, from Bass Straits. Mr. Wilson's collection contains seventeen examples of it. The sponge is massive and usually contains much sand. The colour in life is orange, pink or brown, as shown by Mr. Wilson's records of twelve specimens.

The species is distinguished from *Tedania digitata* by the smooth-ended tylote diactinal megascleres. As *T. digitata* may also contain a good deal of sand I do not think the two species could be distinguished with certainty without microscopical examination. The amount and disposition of the sand in *T. commixta* varies much.

The stations recorded for the species are 6, 9, x A, x B, Sorrento Jetty.

R.N. 417; 441; 444; 498; 505; 552; 606; 747; 768; 769; 772; 781; 863; 960; 996; 1062; 1148.

Genus *Stylotrichophora*, n. gen.

The main skeleton is a network of horny fibre cored with foreign bodies. In addition to this there are smooth monactinal megascleres (styli) and hair-like microscleres (rhaphides).

The genus is perhaps related to Marshall's *Phoriospongia*, but differs in the distinct reticulate horny fibre, and in the presence of rhaphides instead of sigmata for microscleres.

Stylotrichophora rubra, n. sp.

The single specimen is compressed, lobose and little more than half an inch thick. The surface is smooth and even. The vents are very small and chiefly marginal. The texture is fairly compact, resilient. The colour in life was coral red, disappearing in spirit.

Skeleton, the main skeleton is an irregular, wide-meshed reticulation of stout horny fibre, everywhere abundantly cored with foreign bodies (broken spicules), but with a layer of more or less clear, transparent spongin outside the core. The primary fibres are about 0·25 mm. thick, sometimes more, and the secondary, connecting fibres a good deal more slender. Between these fibres is a loose but abundant spicular skeleton of slender megascleres, for the most part irregularly scattered, but collected into loose whisp-like fibres towards the surface. These spicular fibres seem to spring from the horny fibres of the main skeleton and break up at the surface into loose tufts of projecting styli whose ends penetrate the dermal reticulation.

The dermal skeleton is a very beautiful, close-meshed reticulation of foreign bodies (broken spicules) held together by spongin. The meshes of this dermal network are nearly circular and about 0·18 mm. in diameter. In some places the foreign bodies form an uninterrupted layer.

Megascleres, long, smooth, slender styli, usually slightly curved and finely pointed, measuring about 0·27 by 0·004 mm., but variable and sometimes a good deal longer.

Microscleres, very long and slender, hair-like rhaphides, usually collected into long fibrous whisps.

R.N. 478 (x, 20 f; "coral red").

ART. XXV.—*List of Dredging Stations at and near Port Phillip Heads.*

By J. BRACEBRIDGE WILSON, M.A., F.L.S.

[Read 13th December, 1894.]

Station I.—Bounded on the E., by a line from the W. Quarantine boundary flagstaff to the Pope's Eye Buoy. On the N., line from Pope's Eye Buoy to Point Lonsdale. On the W., line from Point Nepean to the channel marks on the shore in Lonsdale Bight.

Depth, very variable, 8–9 fathoms, and in parts 15–21 fathoms.

Station II.—Mid channel just inside the Rip at the Heads.

Depth, 18–32 fathoms. Almost impracticable for working owing to the strength of the tides.

Station III.—Lonsdale Bight, inshore of the Upper and Lower Kelp.

Depth, 3–6 fathoms.

Station IV.—S.E. boundary, the same as the N.W. boundary of Station I. N.E. boundary, in line from Pope's Eye Buoy to Lower Queenscliff Lighthouse. S.W. boundary, flagstaff W. of Quarantine Ground in line with the channel marks on shore in Lonsdale Bight.

Depth, 8–15 fathoms.

Station V.—S.W. boundary, Pope's Eye Buoy in line with the Lower Lighthouse. On the E., Pope's Eye Buoy in line with Swanspit light, extending N.E. about to within a quarter of mile of the Royal George Shoal.

Depth, 6–7 fathoms.

Station VI.—The entrance to Symond's Channel from a line between the Pope's Eye Buoy and No. 1 Black Perch Buoy, about one mile and a half up channel.

Depth, 7–9 fathoms.

Station VII.—From the flagstaff at the W. boundary of the Quarantine Ground to Point Franklin, commonly called Quarry Point, along shore from about a quarter to three quarters of a mile out.

Depth, 8–16 fathoms.

Station VIII.—The entrance to the South Channel from a line between No. 1 Perch Buoy on the N. to No. 2 Buoy on the S. of the channel. The E. boundary, a line from Point King to the western end of Mud Island.

Depth, 8–16 fathoms.

Station IX.—The South Channel from the E. boundary of Station VIII. to near the South Channel Fort.

Depth, 9–11 and in one part 20–21 fathoms.

Station X.—Limeburners' Channel in Capel Sound from near the White Buoy off the Sisters to about half-a-mile beyond Canterbury Jetty.

Depth, 6–10 fathoms.

Station XI.—Capel Sound between the White Cliff and the South Channel Pile Light.

Depth, 6–8 fathoms.

Station XII.—The southern part of Dromana Bay. No. 15 Buoy, in line with the South Channel Shore Light.

Depth, 8–10 fathoms.

Station XIII.—Off Mount Martha.

Depth, 10–13 fathoms.

Station XIV.—From the N. entrance of the Pinnace Channel to the E. entrance to Symond's Channel, along the edge of Mud Island Bank.

Depth, 4–8 fathoms.

Station XV.—Prince George Bank, N. of Indented Head.

Depth, $1\frac{1}{2}$–$2\frac{1}{2}$ fathoms.

OUTSIDE THE HEADS.

Station XA.—About 2½–3 miles out from Point Lonsdale, Mount Duneed showing well clear of Barwon Head.

Depth, 17–19 fathoms.

Station XB.—About 5 miles out with the same stream mark.

Depth, 25-31 fathoms.

Station XC.—Off Barwon Head and Ocean Grove, about 6 miles from Point Lonsdale, and 2–3 from shore.

Depth, 19–25 fathoms.

Art. XXVI.—*Preliminary Notice of certain New Species of Lizards from Central Australia.*

By A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S.

[Read 13th December, 1894.]

The following contains a description of five new species and one new variety of lizards collected in Central Australia during the visit of the Horn Expedition. The full descriptions, accompanied by figures, together with a complete report, will be published in the volume dealing with the work of the Expedition.

Ebenavia horni, sp. nov.

Description.—Head long, depressed; snout rather obtuse, about as long as the distance between the eye and the ear-opening. Pupil vertical. Ear-opening small, round. Limbs short and slender. Tail depressed, constricted at the base. Digital expansions twice the diameter of the digit. Lamellæ under the fourth toe eight, separated from the expansions by rows of granules. Dorsal surfaces of expansions scaled as in *Phyllodactylus*. Upper surfaces of body covered with uniform small, oval scales; scales on the head round, smallest on the occiput, largest and flattest on the snout. Rostral very low, four-sided, four times as broad as high. Nostril pierced between first labial and three or four nasals; first nasal largest, separated from its fellows on the opposite side by a single equal scale, thus forming a line of three scales behind the rostral. Nine upper labials. Mental narrow, triangular, about as large as adjacent lower labials; latter nine in number. No special chin-shields, but the gular scales near the symphysis larger than those behind. Ventral scales smooth, tesselated, larger than dorsal. Tail with annuli of small smooth scales. *Colour.*—Olive-brown above, with four longitudinal dark bands, two converging from the occiput to unite over the sacrum, and one on each side passing from the nostril through the eye and above the limbs. On the side another dark band from ear, just above the fore-limb to the

groin. Under surfaces brownish-grey with scattered brown dots. Tail brown above with lighter ocelli, each occupying about four scales; below with intermingled grey and brown scales.

DIMENSIONS.

Total length	...	...	55 mm.
Head	...	...	10 „
Width of head	...	...	5 „
Body	...	...	23 „
Fore-limb	...	...	9 „
Hind-limb	...	...	12 „
Tail	...	...	22 „

Since Mr. Boulenger has withdrawn his species *E. boettgeri*, (Cat., vol. iii., p. 482), only one *Ebenavia* has been previously recognised, and that only from Madagascar. In general outline the present species closely agrees with Mr. Boulenger's figure (Cat., vol i., pl. viii., fig. 1), and the colour bands agree fairly with those of his Madagascar specimen. The chief point of distinction in the Australian form is the entire absence of anything like longitudinal series of large tubercles.

The nearest allies to the clawless genus *Ebenavia* are met with in the genus *Phyllodactylus*. Species of *Phyllodactylus* occur in South Africa and Madagascar. Indeed, only the most trivial differences can be found between *P. porphyreus*, Daud., from these localities, and the widely distributed Australian form *P. marmoratus*, Gray.

We have associated the name of Mr. Horn with this interesting lizard.

Tympanocryptis tetraporophora, sp. nov.

Nostril nearer to eye than to tip of snout; upper head scales larger and less strongly keeled than in *T. lineata*, Peters, large on the occiput. Dorsal scales strongly keeled, the enlarged ones mucronate. *Colour.*—Light brown above or reddish, with darker more or less indistinct cross bands on the body; tail and limbs with dark bars. Resembling *T. cephalus*, Günth., in colouring above, and *T. lineata* on ventral surfaces; but in one of the two specimens there is a narrow white vertebral line recalling that of *T. lineata*.

The remarkable feature of these specimens is that there are in addition to the two anal pores, two femoral pores, one on each limb. This character will involve a modification in the definition of the genus.

Apart from the presence of these pores, *T. tetraporophora* serves to connect the two previously described species of the genus.

DIMENSIONS.

Total length	...	...	130	mm.
Head ...	...	...	17	,,
Width of head	...	...	13	,,
Body ...	...	...	35	,,
Fore-limb	...	...	28	,,
Hind-limb	...	...	40	,,
Tail ...	...	...	78	,,

Varanus gilleni, sp. nov.

Description.—Snout slightly projecting, depressed at the end, measuring rather less than the distance from the anterior angle of the eye to the ear; canthus rostralis indistinct. Nostril broadly oval, as in *V. punctatus*, *acanthurus*, etc., directed backwards and outwards, slightly nearer the end of the snout than the anterior angle of the eye. Limbs and digits moderate, latter strongly compressed. Tail round, flattened ventrally, depressed at the base, not keeled. Head covered with flat granular scales, unequal in size, largest between the orbits, smallest on the supraocular region and about the nostrils. Scales of upper surfaces small, oval, convex, rather longer than broad, each scale on the body and limbs—except those on the preaxial surface of the carpus and to a less extent the tarsus—surrounded by a conspicuous ring of small granules. About eight rows of flat smooth subequal genal scales. Gular scales similar to abdominal, but more convex. Abdominal scales smooth, in eighty-five to ninety transverse rows between gular fold and groin. Caudal scales all tricarinate, the central keel strongest, raised posteriorly almost mucronate. Pineal cornea distinct, inconspicuous. *Colour.*—Light brown above, with darker spots and streaks, arranged more or less plainly in longitudinal series or continuous

lines on the head and the distal three-fourths of the tail, and in transverse series or bands across the neck, trunk, and proximal fourth of the tail. The markings on the trunk of a dull red. Six narrow longitudinal bands on the head and front part of the neck, on each side one commencing behind the ear and another more continuous along the temporal region commencing behind the eye, the two median dorsal bands anastomosing with one another and with the temporal streak. Lips with vertical streaks. Under surfaces cream coloured, chin dark spotted.

DIMENSIONS.

Total length	341 mm.
From tip of snout to gular fold ...	51 „
From gular fold to vent	93 „
Max. width of head	17 „
Fore-limb	38 „
Hind-limb	46 „
Tail	197 „

Named after F. J. Gillen, Esq., the chief officer of the Alice Springs Telegraph Station.

Varanus eremius, sp. nov.

Description.—Snout depressed at the end, measuring less than the distance from the anterior border of the orbit to the ear, canthus rostralis sharp. Nostril round, nearer the end of the snout than the orbit. Digits moderate. Tail round, depressed at the base, compressed posteriorly. Head scales small subequal, supraocular scales very small. Scales of the upper surfaces small, elongate, keeled. Abdominal scales smooth, in seventy to seventy-five transverse rows, caudal scales strongly keeled, the caudal keel with a low doubly-toothed crest. Pineal cornea conspicuous. *Colour.*—Rusty-brown above, with small lighter and darker spots, a dark narrow curved line across the back of the head, and another from above the ear passing through the orbit, lower eye-lid with a large brownish-grey spot, sides greyish, a white streak from the ear to the fore-limb. Tail greyish with four—six on the anterior half—black streaks. Lower surfaces white, throat mottled with grey.

DIMENSIONS.

Total length	300 mm.
From tip of snout to gular fold ...	39 „
From gular fold to vent	73 „
Max. width of head	13 „
Fore-limb	32 „
Hind-limb	46 „
Tail	188 „

Rhodona tetradactyla, sp. nov.

Description.—Body much elongate, limbs weak, tetradactyle, the distance between the end of the snout and the fore-limb is contained twice to twice and a half in the distance between axilla and groin. Snout moderate, obtusely conical. Lower eye-lid with a transparent disk. Nostril pierced in a large nasal which is in contact with its fellow; frontonasal large, and forming a broad straight suture with the frontal; præfrontals small and widely separated; frontal broader than the supraocular region, longer than the frontoparietals and interparietal together, in contact with the first and second supraoculars; four supraoculars, six supraciliaries; frontoparietals and interparietal distinct, subequal; two or three pairs of nuchals. Ear-opening minute, about the size of the nostril. Twenty smooth scales round the middle of the body, dorsals largest. A pair of enlarged præanals. The length of the hind-limb equals the distance between the eye and the fore-limb; toes slender, third about twice the length of second, which is twice as long as the first, subdigital lamellæ smooth, about fourteen under the third toe. Tail slightly longer than head and body. *Colour.*—Greyish above, with four regular series of black dots, almost confluent into lines along the back, sides darker, a longitudinal blackish lateral band from snout to tail, the lower edge of which is scarcely distinct from the darker ground colour on the sides; tail brownish, covered with irregular blackish dots; lower surfaces greyish or brownish with a darker colour around the margin of each scale.

DIMENSIONS.

Total length	...	...	77 mm.
Head	...	...	5 „
Width of head	...	...	3 „
Body	...	...	30 „
Fore-limb	...	...	4 „
Hind-limb	...	...	8 „
Tail	...	...	42 „

Ablepharus lineo-ocellatus, D. and B.

Var. *ruficaudus*, var. nov.

Differs from the type as follows:—Body much depressed. Twenty-eight scales round the middle of the body. Nuchals nearly as large as parietals. *Colour.*—Upper surfaces greenish-black, with conspicuous longitudinal white band on either side of the back and head, converging in front to meet on the tip of the snout, and behind extending to base of tail. Tail and hind-limbs red. Under surfaces of body bluish-white, of tail reddish.

Art. XXVII.—*Some Quantitative Laws of Incubation and Gestation.*

By Alexander Sutherland, M.A.

[Read 13th December, 1894.]

It is known in a general way that the time required for hatching out the eggs of cold-blooded animals is dependent on the temperature at which they are kept. Professor McIntosh ("Nature" xxxi., p. 555) says that salmon eggs left in the sea, take from 95 to 120 days to hatch, but that when transferred to a warm room they hatch in 60 days. Bertram, in his "Harvest of the Sea," says that herring eggs will hatch slowly or quickly according to the temperature, a difference of 50 days being possible. As a rule herring eggs take from 11 to 40 days, graylings from 14 to 40, codfish 5 to 42, tench 6 to 14, gurnards 7 to 35, stickleback 10 to 30, and so on, the higher the temperature the less the time. But in connection with a book on which I have long been busy, I required more definite information as to the relation of hatching-time to temperature, and therefore I instituted a long series of hatchings of frogs' eggs. During two winters I took the eggs of a species which Professor Spencer identified for me as *Hyla aurea*, and hatched its eggs in sets at graduated temperatures. This species extrudes an unusual number of eggs, the average of 14 sets that I counted being over 3000 to each. It was easy therefore to get ten sets of 100 each, which could with certainty be regarded as of similar condition. I put them over lamps and kept them at temperatures, as nearly uniform as I could, ranging from 10° C. to 33° C.

Six series of experiments thus conducted satisfied me that the time required for hatching was inversely proportional to the square of the excess of the temperature above a certain fixed temperature. But in every series there occurred one or more failures through accidental variations in temperature. I, therefore, in September last, carried out a new series of experiments, floating each set of eggs in a large body of water which could not easily vary during intervals between observation. Even here one set was somewhat affected by a rise of 3° C. lasting for 4 hours,

during an unavoidable absence. I give the table herewith, without any attempt at compensating for errors. The law which they clearly indicate is that

$$t = \frac{m}{(T+a)^2}$$

where t is the time of hatching, T is the temperature at which the eggs are kept; m and a are constants, the latter being of course the fixed temperature referred to. The last column gives the time (in hours) which the eggs would have taken to hatch according to this law, assuming $m = 40{,}200$; and $a = 1{\cdot}3°$ C. for this species.

TABLE I.

No.	Average Temperature.	Time Observed.	Time Calculated.
1	31·6° C	Killed by heat.	
2	29·3° C	43 hours	42·9 hours
3	28° C	45 ,,	46·8 ,,
4	24·1° C	62 ,,	62·2 ,,
5	22·8° C	68 ,,	69·3 ,,
6	21·7° C	71 ,,	76 ,,
7	17·6° C	114 ,,	113·5 ,,
8	17·5° C	114 ,,	114 ,,
9	15·8° C	138 ,,	137·5 ,,

No. 6 is the set already referred to as having been marred by an accident; but the general agreement of the figures can leave no doubt as to the accuracy of the law.

In the formula given it is plain that a temperature of $-1{\cdot}3°$ C. would be that at which the eggs would take an infinite time to hatch, or, in other words, would never hatch at all; but at temperatures somewhat above this we may be sure that other circumstances would interfere to prevent the development of the tadpole.

The quantity m is constant only for a given species; but in what follows of this paper, enough will be seen to make it probable that in comparing species with species, it is a quantity varying directly as the sixth root of the weight of the fully matured animal. So far as I can depend on the very few and very rough observations made as to the hatching time of lizards,

snakes, turtles and alligators, this belief is fairly well borne out. But, as the unreliable nature of these figures prevents more than a sort of *prima facie* evidence, let me pass by preference to others in which there is more accuracy, though still the observations are often merely approximate.

All birds and mammals, except the monotremata, and, as I shall show in a future paper, the marsupiata, keep at a temperature which may, for the purposes of this enquiry, be considered constant, so that in the following investigation we may neglect temperature variations, as the figures to be dealt with are not accurate enough to allow of refined adjustments. Excluding the monotremata and marsupiata, the extremes of health temperature for birds and mammals would be 37° C. and 43° C., or a range of only 6° C. We may therefore assume that all birds sitting on their eggs keep them at a tolerably definite temperature. Any given species, therefore, will take a certain fairly definite time to hatch out its eggs. Temperature, we know, counts for something; a set of hen, duck or turkey eggs placed in a warm dry situation will hatch out two or three days before another set in a damp cold place. But, in view of the roughness of the observations of naturalists, we shall assume that each species takes a tolerably definite time in hatching, the hen for instance, 21 days, and the turkey, 28.

What, then, is the reason for the difference in time, seeing that in all cases the temperatures are much the same? Why does a humming-bird take 10 days, or a wren 10, while a dove takes 18, a fowl 21, a turkey, 28, an ostrich about 50? St. George Mivart says: "The period of incubation is much related to the size of the bird." I propose in this paper to determine the nature of that relation, and to show that the time of incubation is directly proportional to the sixth root of the weight of the bird when mature.

The following preliminary table will serve to illustrate this relation and show that $t = n\sqrt[6]{w}$, where t = time in days.

w = weight in lbs.

n = 20.

TABLE II.

Name.	Weight.	Time Observed.	Time Calculated.
Humming Bird - -	150 grains	10 days	10·5 days
Wren - - - -	135 „	10 „	10·3 „
Goatsucker - -	2½ oz.	14 „	14·6 „
Lark - - - -	4 „	15 „	15·8 „
Kingfisher - - -	7½ „	17 „	17·6 „
Pigeon - - -	12¼ „	18 „	19·1 „
Pheasant - - -	2¼ lbs.	24 „	23·3 „
Common Fowl - -	3 „	21 „	24 „
Guinea Hen - -	9 „	28 „	28·9 „
Duck - - - -	6 „	28 „	27 „
Turkey - - -	12 „	29 „	30·2 „
Goose - - - -	12 „	32 „	30·2 „
Eagle - - - -	12 „	30 „	30·2 „
Ostrich - - -	250 „	38 to 60 days	50·1 „

In an appendix to this paper I shall give a list of 105 birds, for which I have been able to obtain records of the weight and of the incubation period of each. I have, indeed, found records of the weights of over 500 species and incubation periods of an almost equal number; but in only these 105 cases can both items of information be had for the same bird. They are sufficient, however, to show that the law enunciated holds good with only one notable exception, the Apteryx, which is wholly isolated if the figures given by Buller are to be accepted. There is one dubious case—the Emu. But in such an enquiry allowance must be made for the want of definiteness in the figures. Many observers are content to say that a bird broods for 3 or 4 weeks. Even so careful a writer as Brehm, gives very many of his incubation periods in the same inaccurate fashion. Nor do the authorities agree well together. For a bird so well-known as the Swan, Brehm gives 48 days as the period; poultry books say 6 weeks, while Bechstein, a very competent authority, gives 5 weeks. In regard to the ostrich, Anderson gives 38 days, Brehm gives 45 to 52, while St. George Mivart says 50 to 60, and half-a-dozen other authorities give various intermediate periods. In all such cases I have taken the mean. But there are many, no doubt, not to be accepted as more than very rough approximations.

In a few cases where, instead of the name of the authority for the weight, the word "calculated" occurs, it means that, being unable to find the weight of a species, but having discovered that of a closely allied species, presumably of the same shape, I have calculated the weight of the one from that of the other on the assumption that they are proportional to the cubes of the lengths.

If we apply the same sort of investigation to the Mammalia as a whole, we find that for the period of gestation the law

$$t = n \sqrt[6]{w}$$

holds with only moderate accuracy. But if we consider any one order at a time, the coincidence of observed and calculated times is sufficient to establish the law conclusively. For instance, the following is a list of all the carnivora for which I can obtain information. For this order the constant n is equal to 41.

Table III.

Popular Name.	Specific Name.	Weight, in lbs.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Cat	Felis maniculata	6	Experiment	55	55 to 56	Mivart, Brehm, &c.
Wild Cat	Felis catus	16	Brehm	65	63	Brehm
Lynx	Lynx vulgaris	18	Brehm	66·5	70	Brehm
Chaus	Lynx chaus	15	Brehm	64·4	70	Brehm
Lion	Felis leo	490	Jerdon	113	110	Average of seven
Puma	Felis concolor	160	Calculated	95·5	96	Brehm
Tiger	Felis tigris	332	Brehm	108	100 to 105	Brehm
Leopard	Felis panthera	150	Calculated	94·7	90	Brehm
Ferret	Putorius furo	1	Cyclopædia	41	35 42	Brehm Vogt.
Weasel	Putorius vulgaris	½	Cyclopædia	36·5	35	Brehm
Otter	Lutra vulgaris	19	Flower & Lydekker	67	63	Brehm
Polecat	Putorius fœtidus	6		55	55 to 60	Brehm
Wolverine	Gulo borealis	96	Brehm	87·7	90	Vogt.
Marten	Mustela martes	8		57	63	Brehm
Badger	Meles taxus	44	Brehm	77·1	84 to 105	Brehm
Racoon	Procyon lotor	15	Cyclopædia	64·4	63 to 70	Brehm
Brown Bear	Ursus formicarius	550	Brehm	187	180	Vogt
Polar Bear	Ursus maritimus	800	Vogt.	199	210	Brehm
Land Bear	Ursus arctos	440	Brehm	180	180	Brehm
Jackal	Canis aureus	22	Brehm	74·7	63	Brehm
Wolf	Canis lupus	90	Brehm	86·9	70	Landois
Fox	Canis vulpes	6 16	Jerdon Brehm	55 65	62 63	Brehm Landois

The dog family are here the most abnormal, and, among domesticated dogs, although the larger varieties have a longer gestation period than the smaller, the difference is not sufficient to make the times accord with the law given.

The ruminants form another group fairly consistent within itself; but for them the constant n must be made equal to 80.

The camel and giraffe families are left out of the following list, the former for want of weights of individuals, the latter because the gestation period is abnormally long. But of the Cervidæ, Capridæ, and Bovidæ, the following are all the species for which I can find both weights and gestation periods recorded.

TABLE IV.

Popular Name.	Specific Name.	Weight, in lbs.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Roebuck	Capreclus caprœa	50	Brehm	153	160	Brehm
Stag	Cervus elaphus	450	Brehm	221	280	Brehm
Fallow Deer	Dama vulgaris	220	Brehm	196	240	Brehm
Elk	Alces palmatus	750	Brehm	242	259	Brehm
Saiga	Colus tartaricus	120	Brehm	178	165	Brehm
Gemsbok	Capella rupicapra	90	Brehm	169	150	Brehm
Goral	Nemorhœdus goral	200	Jerdon	193	180	Brehm
Nilgau	Portax pictus	800	Brehm	244	240	Brehm
Elend	Busephalus oreas	1000	Brehm	253	282	Brehm
Koodoo	Strepsicorus kudu	400	Brehm	217	210 to 240	Brehm
Wild Cattle	Bos taurus	800	Brehm	244	280	Brehm
Bison	Bison europæus	1320	Brehm	265	280	Brehm
Yak	Bos grunniens	1100	Brehm	257	270	Brehm
Musk Ox	Ovibos moschatus	800	Brehm	244	270	Brehm
Mufflon	Ovis musimon	100	Brehm	172	147	Brehm
Argali	Ovis argali	400	Brehm	217	210	Brehm
Ibex	Capra ibex	170	Brehm	188	150	Brehm
Reindeer	Rangifer tarangus	400	Cyclopædia	217	210	Brehm
Musk Deer	Moschus moschiferus	50	Cyclopædia	153	180	Brehm
Sheep	Ovis aries	100	Av. of 7 weighed	172	150	Av. of 5 observers
Goat	Capra hircus	100	Calculated	172	154	Av. of 4 observers

More accurate results may be had by taking the families separately and adopting for each its own value of n, these values being nearly, but not quite, equal. In the same way by putting $n = 55$ we find that the *Suidæ* and *Hippopotamidæ* make a consistent group, though not running uniformly with the rest of the *Artiodactyls*.

The period of gestation among these animals is generally only roughly determined by observing in what months the sexes come together, and then observing in what month the young are born. How fallacious this may be has been shown by Bischoff in the case of the Roebuck, the female of which does not produce her young until more than nine months after the rutting season. But it is now known that this is not the period of gestation, for the spermatozoa lie for four months in the uterus without fertilising the ovum, so that the real period is only some five months. The same phenomenon is observed with bats and other mammals. Selenka has shown that with the Virginian Opossum the time from copulation to birth is 13 days while the actual time of gestation is only $7\frac{5}{6}$ days. So in the U.S. Fisheries' Report of 1884, the statement is made that while the males of *Embiotocidæ* impregnate the females in autumn the young are born alive in the following summer. Hence the spermatozoa must lie inactive for many months.

It is quite probable, as the foregoing list suggests, that beside the Roebuck, there are other species of deer in which the same peculiarity occurs to a less extent. Perhaps the same thing occurs in the case of the Beaver which is a very aberrant species, as will be seen from the list given in the appendix of all the Rodentia for which information is available. The *Perissodactyla* make another consistent group. All the species for which information is available are given in the appendix.

In dealing with the mammals we have found it necessary to give different values to the constant. There are two biological reasons for this. The first is that some animals are carried by their mothers till fairly well able to take care of themselves. A calf, or a foal, or a young deer is sufficiently matured to trot after its mother in a few hours after birth; while a kitten, or a puppy, or a tiger cub is for a long time helpless. One animal therefore remains in its mother's womb until tolerably complete

as compared with another. This causes the value of n to be high in ruminants, and higher still in Proboscidea; while in Carnivora and Rodentia it is low, but of approximately equal value, 41 for the first; 35 for the second.

The first law, stated in its most general form, is this:—"For animals of the same size the time of embryo development is inversely proportional to the square of the temperature, that temperature being reckoned from a definite point."

The second law, similarly stated, is that:—"At the same temperature, the period of development is directly proportional to the sixth root of the weight of the mature animal."

This latter law is capable of a certain simplification. If two animals are of different sizes, but of the same shape, the weights of their bodies are proportional to the cubes of their lengths. The law in that case would be:—At the same temperature, among animals of the same shape, the period of development is directly proportional to the square root of the length.

Thus we have

$$t = n\sqrt{l}$$

but this is the same as

$$l = ft^2$$

where $f = \frac{1}{n^2}$.

Now this is the well-known equation for the space traversed by a body moving under the influence of a constantly accelerating force, and the significance of the law therefore is that if we consider the germinal point as the starting place, and imagine the embryo to travel outwards from it to the periphery, the velocity of the motion will be such as would result from a constantly accelerating force propelling it from the germinal spot outwards.

In the appendix a list is given of the gestation periods of the rodents, the family Leporidæ being set down apart from the others as requiring a lower value of the constant. The Beaver is a very aberrant case. The only four species of Perissodactyls for which I can get information form a fairly consistent group. For them the value of the constant is very high, but in the Proboscidea it rises higher than in any other of the lower families, reaching a value of 120. In the Prosimia it appears to be only equal to the value of n in the ruminants; but in the Quadrumana

it rises to 160, and in mankind remains at about the same value.

This increase in the value of n as nerve development progresses, is a ready corollary from Von Baer's law, but many difficulties arise in the attempt to work out the relation in a general way.

One may almost risk the prediction that the laws above stated will be found to combine in this fashion :—

I.—Reckoning t to be the time from the fusion of the nuclei to some definite point in development, say, the capacity of the young animal to stand, walk or swim ; T to be the temperature at which development takes place, and w to be the weight of the mature animal. Then as a first approximation

$$t = \frac{k\sqrt[6]{w}}{T^2}$$

T being reckoned from a definite point ; not necessarily any of the recognised zeros.

II.—But the quantity t tends decidely to increase with increase of nerve complexity, as gauged by size and efficiency of brain.

APPENDIX I.

INCUBATION PERIODS OF BIRDS.

$$t = n \sqrt[6]{w} \text{ where } n = 20.$$

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Swallow - -	Hirundo rustica - -	1 oz.	Experiment -	12·5	12	Brehm
Canary - - -	Dryospiza canaria - -	600 grs.	Bp. Stanley -	13·2	14	Jones
Greenfinch - -	Chloris hortensis - -	480 grs.	Bp. Stanley -	12·9	13	Jones
Goldfinch - -	Carduelis elegans - -	540 grs.	Bp. Stanely -	13·1	13	Jones
Goatsucker - -	Caprimulgus kelaartii -	2½ oz.	Jerdon - -	14·6	14	Jerdon
Trogon - - -	Harpactes fasciatus -	2½ oz.	Audubon - -	14·6	20 (?)	Brehm
Halcyon - -	Halcyon leucocephalus -	7½ oz.	Audubon - -	17·6	17	Brehm
Woodpecker - -	Chrysocolaptes sultaneus -	6 oz.	Jerdon - -	17	14	Jerdon
Hedge Sparrow -	Tharraleus modularis -	1 oz.		12·5	14	Jones
Wryneck - -	Yunx torquilla - -	1½ oz.	Jerdon - -	13·4	14	Brehm
Nuthatch - -	Sitta cæsia - -	½ oz.	Jerdon - -	11·2	13	Brehm
Shrike - - -	Lanius lahtora - -	2 oz.	Jerdon - -	14·1	15	Brehm
Woodshrike - -	Tephrodornis silvicola -	1½ oz.	Jerdon - -	13·4	13	Brehm
Wren (Common) -	Troglodytes ædon - -	135 grs.	White's Selbome	10·3	10	Mivart
Wren (Winter) -	Troglodytes hiemalis -	300 grs.	Audubon - -	11·9	13	Brehm
Girlitz - - -	Serinus hortulans - -	320 grs.	Audubon - -	12	10	Newton
Chaffinch - -	Tringilla cœlebs - -	1000 grs.	Audubon - -	14·4	14	Newton
Lark - - -	Alauda arvestris - -	1700 grs.	Audubon - -	15·8	15	Newton
House-Sparrow -	Passer domesticus - -	1000 grs.	Audubon - -	14·4	14	Newton
Piping Crow - -	Gymnorhina tibicen -	5700 grs.	Experiment -	19·3	21	Brehm
Martin - - -	Chelidon urbica - -	500 grs.	Calculated -	12·9	12	Brehm

INCUBATION PERIODS OF BIRDS.—*(Continued).*

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Sand Martin	Cotyle riparia	400 grs.	Calculated	12·4	14	Brehm
Flycatcher	Muscicapa albicollis	600 grs.	Calculated	13·2	14	Brehm
Robin Red-breast	Erithacus rubeolus	700 grs.	Calculated	13·7	14	Brehm
Sedge Warbler	Calamodus phragmitis	500 grs.	Calculated	12·9	14	Brehm
Pendulous Titmouse	Ægithalus pendulinus	400 grs.	Calculated	12·4	14	Brehm
Long-tailed Tit	Orites caudatus	500 grs.	Calculated	12·9	13	Brehm
Honeysucker	Nectarinia metallica	600 grs.	Calculated	13·2	14	Brehm
Humming Bird	Trochilus colubris	150 grs.	Calculated	10·5	10	Brehm
		12 lbs.	Jerdon	30·2	35	Brehm
Eagle (Golden)	Falco chrysaëtos	15 lbs.	Jerdon	31·4	21 to 35	
		11 lbs.	Audubon	29·8	21	Gray
Snake Buzzard	Circaëtus brachydactylus	4¼ lbs.	Jerdon	25·4	28	Jerdon
Osprey	Pandion haliætus	3½ lbs.	Jerdon	24·7	24	Brehm
Vulture	Vultur cinereus	19 lbs.	Jerdon	32·6	32	Brehm
Kite	Hydroictinia govinda	7½ oz.	Jerdon	17·7	21	Brehm
Goshawk	Astur palumbarius	46 oz.	Jerdon	17·6	18 to 20	Brehm
Wood Owl	Syrnium newarnese	2¼ lbs.	Jerdon	23	21	Brehm
Eared Owl	Strix otus	8 oz.	Jerdon	17·8	21	Brehm
Scops Owl	Ephialtes pennatus	2¾ oz.	Jerdon	16·7	21	Brehm
Owlet	Athene brama	4 oz.	Jerdon	15·9	15	Brehm
Stock Dove	Palumbœna eversmanii	7½ oz.	Jerdon	17·6	17	Brehm
Ring Dove	Columba palumbus	6¼ oz.	Jerdon	17·2	17	Darwin
Pigeon	Columba livia	12¼ oz.	Darwin	19·1	18	Brehm
Common Fowl	Gallus	4 lbs.	Experiment	25·1	21	Brehm

INCUBATION PERIODS OF BIRDS.—*(Continued).*

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Jungle Fowl	Gallus ferrugineus	2 lbs.	Le Messurier	22·5	21	Brehm
Pheasant	Phasianus colchicus	2½ lbs.	Brehm	23·3	24	Brehm
Guinea Hen	Numida meleagris	9 lbs.	Poultry Books	28·9	28	Poultry Books
Peahen	Pavo cristatus	8½ lbs.	Le Messurier	28·6	28 30	Poultry Books Brehm
Turkey	Meleagris gallopavo	10 lbs.	Exp. average of 7	29·3	27 to 30	Brehm
Horned Pheasant	Ceriornis satyra	4⅛ lbs.	Jerdon	25·6	26	Brehm
Kaly Pheasant	Gallophasis albocristatus	3 lbs.	Jerdon	24	24	Brehm
Himalaya Snowcock	Tetraogallus himalayensis	6½ lbs.	Jerdon	27·3	28	Brehm
Snow Partridge	Lerwa nivicola	18 oz.	Jerdon	20·7	22	Brehm
Chukkor Partridge	Caccabis chukor	20 oz.	Jerdon	20·8	22	Brehm
Common Quail	Coturnix communis	3¾ oz.	Jerdon	15·7	18	Brehm
Godwit	Scolopax hudsonica	9 oz.	Audubon	18·2	17 to 18	Brehm
Woodcock	Scolopax rusticola	12 oz.	Jerdon	19	18	Brehm
Woodsnipe	Gallinago nemoricola	6 oz.	Jerdon	17	18	Brehm
Common Snipe	Gallinago scolopacinus	4½ oz.	Jerdon	16·2	15	Brehm
Curlew, Red-billed	Ibidorhynchus struthersii	9½ oz.	Jerdon	18·3	16	Brehm
Ruff	Philomachus pugnax	6 oz.	Le Messurier	17	19	Brehm
Partridge	Perdix cinerea	1 lb.	Audubon	20	21 22 26	Jones Audubon Brehm
Sandpiper	Tringa subarquata	2¼ oz.	Audubon	13·8	14	Brehm
Sea Sandpiper	Tringa maritima	3¼ oz.	Audubon	14·7	16 to 17	Brehm
Heron	Ardea nobilis	4 lbs.	Le Messurier	25·1	21	Brehm

INCUBATION PERIODS OF BIRDS.—*(Continued).*

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Ibis	Geronticus papillosus	3¼ lbs.	Jerdon	24·3	25	Brehm
Stork	Ciconia alba	8 lbs.	Le Messurier	28·3	28 to 31	Brehm
Flamingo	Phœnicopterus roseus	10 lbs.	Jerdon	29·3	32	Brehm
Clattering Rail	Rallus crepitans	11 oz.	Audubon	18·8	21	Brehm
Gallinule	Gallinula chloropus	12 oz.	Audubon	19·1	20	Brehm
Prairie Hen	Tetrao cupido	2 lbs.	Audubon	22·5	18 or 19	Brehm
Knot	Tringa islandica	6 oz.	Audubon	17	16	Brehm
Avocet	Recurvirostrata americana	15 oz.	Audubon	19·8	17 to 18	Brehm
Stilt	Himantopus ingricollis	5¾ oz	Audubon	16·9	16	Brehm
Swiss Plover	Charadrius helveticus	6½ oz.	Audubon	16·5	16	Brehm
Shield Drake	Vulpanser tadorna	3 lbs.	Audubon	24	26	Jones
Domestic Duck	Anas domestica	6 lbs.	Exp. average of 7	27	28	Poultry Books
Mallard	Anas boschus	2¾ lbs.	Audubon	23·6	21	Landois
Teal	Querquedula angustirostris	24 oz.	Le Messurier	21·4	21	Brehm
Wild Goose	Anser cinereus	12 lbs.	Jerdon	30·2	32	Brehm
Cormorant	Phalocrocorax carbo	7½ lbs.	Audubon	28 0	28	Brehm
Crested Grebe	Podiceps cristatus	2½ lbs.	Audubon	23·3	21	Brehm
		2¼ lbs.	Bp. Stanley	23		
Pochard	Clangula glaucion	2 lbs.	Le Messurier	22·5	22	Brehm
Snow Goose	Anser hyperboreus	6¾ lbs.	Audubon	27·5	28	Brehm
Canada Goose	Anser canadiensis	6½ lbs.	Audubon	27·3	28	Brehm
Ruddy Sheldrake	Casarca rutila	4 lbs.	Jerdon	25·1	22 to 23	Naumann
Pelican	Pelecanus onocrotalus	25 lbs.	Jerdon	34·2	38	Brehm
Oyster Catcher	Hæmatopus palliatus	1¼ lbs.	Jerdon	20·8	21	Brehm

INCUBATION PERIODS OF BIRDS.—*(Continued).*

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Seagull - -	Larus argentatus - -	12 oz.	Average of several	19	18	Brehm
Spotted Redshank -	Totanus fuscus - -	8 oz.	Le Messurier -	17·8	15	Brehm
Swan - - -	Cygnus buccinator -	19½ lbs.	Audubon - -	32·8	35	Bechstein
Skua - - -	Lestris catarractes -	3 lbs.	Calculated -	24	28	Brehm
Herring Gull - -	Larus argentatus - -	22 oz.	Audubon - -	21·1	18	Brehm
Guillemot - -	Uria troile - -	2 lbs	Audubon - -	22·5	24	Brehm
Large-billed Guillemot	Uria brunnichii - -	2¼ lbs.	Audubon - -	23	30	Brehm
Cormorant - -	Phalocrocorax floridanus -	3½ lbs.	Audubon - -	24·7	28	Brehm
Pomarine Jager -	Lestris pomarinus - -	1½ lbs.	Audubon - -	21·4	28 (?)	Brehm
Red-headed Duck -	Ferina anas - -	2lbs. 7oz.	Audubon - -	23·2	22	Brehm
Bonaparte's Seagull -	Larus bonaparti - -	10 oz.	Audubon - -	18·5	18	Brehm
Ostrich - -	Struthio camelus - -	250 lbs	Various - -	50·1	50 to 60	Mivart
		165 lbs.	Brehm - -	46 7	45 to 52	Brehm
Apteryx - -	Apteryx oweni - -	4 lbs.	Buller - -	23·3	38	Anderson
					42	Buller
Great Bustard - -	Otis tarda - - -	20 lbs.	Jerdon - -	33	29	Brehm
Indian Bustard -	Eupodotis edwardsii -	27 lbs.	Jerdon - -	34·6	35	Brehm
Rhea - - -	Rhea americana - -	54 lbs.	Calculated -	38 9	39	Brehm
Emu - - -	Dromæus novæ-hollandiæ -	100 lbs.	Calculated -	43·1	58 (?)	Brehm
					49	Sclater
					30	Wallace
Cassowary - -	Casuarius galeatus -	100 lbs.	Calculated -	43·1	58	Brehm
					52	Nicholls
					65	Landois

Appendix II.

RODENTS (excluding Leporidæ). $t = n \sqrt[6]{w}$ where $n = 35$.

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
				Days.	Days.	
Mouse - - -	Mus musculus - -	1 oz.	Average of 7 -	22	22 to 24	Weissman
Rat - - -	Mus decumanus - -	12 oz.	Average of several	33·4	35	Landois
Marmot - -	Arctomys alpinus - -	2 lbs.	Calculated -	39·3	35	Brehm
Beaver - - -	Castor fiber -	{ 35 to 58lbs.	Morgan - -	66·4	{ 90 to 120	Morgan
		{ 44 to 66lbs.	Brehm - -	68·3		
Dormouse - -	Myoxus glis - -	4 oz.	Cyclopædia -	27·8	24 to 30	Brehm
Squirrel - -	Sciurus europæus - -	8 oz.	Brehm - -	31·2	28	Brehm
Guinea-Pig - -	Anæma porcellus -	{ 2 lbs.	Experiment -	39·3	{ 49	Landois
		{ 1lb. 3oz.	Darwin - -	36·1	{ 28 to 35	Brehm
Zizel - - -	Spermophilus citillus -	1 lb.	Brehm - -	35	25 to 30	Brehm
Porcupine - -	Histrix cristatus - -	33 to 44lbs.	Brehm - -	64·2	49 to 63	Brehm

LEPORIDÆ. $t = n \sqrt[6]{w}$ where $n = 24$.

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
Rabbit - - -	Lepus cuniculus - -	2¾ lbs.	Average of 4 -	30	30 to 32	Various
Hare - - -	Lepus vulgaris - -	8 lbs.	Average of 3 -	34	32	Landois

PERISSODACTYLA. $t = n \sqrt[6]{w}$ where $n = 108$.

Popular Name.	Specific Name.	Weight.	Authority.	Time Calculated.	Time Observed.	Authority.
Horse - - -		823 lbs.	Stonehenge -	331	330	{ Brehm Youatt, &c.
Ass - - -		400 lbs.	Calculated -	293	290	Brehm
Tapir - - -		1500 lbs.	Calculated -	366	315	Brehm
Rhinoceros - -		4500 lbs.	Brehm - -	439	510 to 540	Brehm

ART. XXVIII.—*Contributions to a knowledge of the Rhynchota of Australia.*

By E. BERGROTH, M.D.

[Communicated by Professor Baldwin Spencer.]

Through the kindness of Mr. Charles French, of Melbourne, I have received for examination a considerable number of Australian Rhynchota Heteroptera, many of which are new to science and some of great interest, either as belonging to groups or genera not hitherto recorded from Australia, or as constituting new genera. The following pages are devoted to descriptions of some of the most remarkable of these insects. In a second paper I shall continue these descriptions and give a list of all species.

Fam. SCUTELLERIDÆ.

1. *Philia regia*, n. sp.

Parce subtiliter pilosula. Caput modice declive, longitudine paullo latius, parce punctulatum, supra cupreo-purpureum, lateribus viridi-æneum, subtus cæruleum, rostro flavido, antenuis nigris, articulis duobus primis flavidis, secundo primo breviore, tertio secundo fere duplo longiore. Pronotum lateribus ante medium leviter sinuatum, cupreo-purpureum, lobo antico, margine apicali excepto, viridi-æneo, intra marginem apicalem subuniseriatim punctato, lobo postico antico plus quam duplo longiore, margine laterali flavido. Scutellum flavum, dilute fusco-punctulatum, apice subtruncatum, macula basali subcordata latissima callum basalem includente sed latera haud attingente cupreo-purpurea. Corium limbo costali flavidum. Pectus cæruleum, prope angulos posticos prosterni flavidos cupreo-splendens, sulco orificiali longiusculo, area evaporativa nigra, margine postico metasterni flavido. Abdomen subtus, spatio angusto medio excepto, sat dense et fortiter punctatum, subvirescenti-cæruleum, limbo laterali intus integro et ultra spiracula extenso flavo. Pedes flavi, tibiis cyansis, tarsis fusco-nigris. Long. ♀ 10, 8 mm.

Queensland.

Structurally allied to *Ph. fulgurans*, Stål, but quite differently coloured.

Fam. Pentatomidæ.

Sub-fam. Pentatominæ.

2. *Cephaloplatys granulatus*, n. sp.

Subobovatus, lurido-stramineus, nigro-punctatus, superne granulis albidis sparsim obsitus. Caput pronoto medio paullo brevius, fortiter parcius punctatum, vitta media supera impunctata præditum, apice leviter incisum, lateribus ante oculos obtuse leviter angulatum, jugis ante tylum contiguis, rostro et articulo primo antenuarum testaceis (ceteri articuli harum desunt). Pronotum antice cum lateribus explanatis fortiter parcius punctatum, parte posteriore densius et minus fortiter punctata, marginibus lateralibus anticis subrectis, crenulatis, angulis opicalibus ultra oculos distincte productis, angulis lateralibus obtusangulariter sinuatis. Scutellum minus dense punctatum, in dimidio basali vitta sublaterali impunctata præditum, punctura intra et præsertim extra has vittas conferta. Pectus parcius fortiter punctatum. Hemelytra apicem abdominis paullum superantia, corio parcius fortiter punctato, paullo extra medium vitta impunctata notato, punctura intra hanc vittam subvittatim nonnihil densata, membrana cinerea, venis circiter sex simplicibus vel furcatis fuscis instructa et inter has remote fuscoguttulata. Abdomen ad angulos apicales segmentorum leviter obtuse prominulum, connexivo nigro-punctato, ventre parce minute fusco-punctulato, spiraculis fuscis. Pedes remote fusco-punctati. Long. ♂ 10, 5 mm.

Queensland.

Very distinct by the granulated upper surface of the body and the impunctate scutellar vittæ.

3. *Cephaloplatys reticulatus*, n. sp.

Ovalis, lurido-stramineus, nigro-punctatus. Caput pronoto medio æquilongum, parce fortiter punctatum, apice incisum, lateribus ante oculos acutiuscule angulatum, jugis ante tylum contiguis, rostro et antennis testaceis, articulo harum tertio (ima basi

excepta) et quarto (parte basali excepta) nigris, articulo secundo plus quam dimidio apicem capitis superante, tertio secundo paullo breviore, quarto secundo subæquilongo (art. quintus deest). Pronotum inter angulos laterales fascia subcallosa flexuosa instructum, parcius punctatum, lateribus explanatis multo fortius et remote punctatis, marginibus lateralibus anticis serrulatis, pone medium leviter sinuatis, angulis apicalibus ultra angulum anteocularem distincte productis. Scutellum inæqualiter punctatum. Pectus parcius punctatum. Hemelytra apicem abdominis paullum superantia, corio subacervatim punctato, membrana subcinerea, venis fuscis sat dense reticulatis. Abdomen ad angulos apicales segmentorum leviter prominulum, connexivo remote nigro-punctato, segmentis hujus basi latiuscule, apice anguste nigris, ventre sat parce et fortiter punctato, macula basali media segmentorum nigra. Pedes parce fortiter nigro-punctati. Long. ♂ 11, 8 mm.

Queensland.

At once distinguished from the other species by the reticulated membrane.

Sub-fam. PHYLLOCEPHALINÆ.

4. *Basicryptus frenchi*, n. sp.

Stramineo-testaceus, dense et sat fortiter nigro-punctatus, macula transversa media ad marginem apicalem pronoti, fascia intus abbreviata ad angulos laterales pronoti exocorioque basin versus nigris, disco pronoti pone medium nigrescente. Caput ante oculos vix sinuatum, vertice gibboso-convexo, jugis tylo multo longioribus, extus subrectis, intus leviter rotundatis et paullo distantibus, antennis nigris, parce testaceo-conspersis, articulo secundo apicem capitis subattingente, tertio secundo paullo longiore, quarto tertio subæquali, quinto quarto distincte longiore. Pronotum linea transversa media callosa impunctata utrinque prope latera oblique antrorsum vergente sed angulos laterales haud attingente instructum, ante hanc lineam fortiter declive, deinde iterum pone medium capitis deplanatum, parte declivi etiam antice linea transversa callosa recta utrinque abbreviata terminata, angulis lateralibus prominulis, acutis, marginibus lateralibus anticis sinuatis, ante medium crenulatis, marginibus

lateralibus posticis anticis longioribus, ad marginem costalem corii obtuse angulatis. Scutellum callo basali medio, callo oblongo prope angulos basales lineisque duabus longitudinalibus callosis ante medium antrorsum leviter divaricatis pallidis impunctatis instructum. Corium quam scutellum minus dense punctatum, venis et margine costali pallidis; membrana albido-hyalina, venis nigris. Segmentum genitale maris apice leviter sinuatum. Pedes dense subconfluenter fortius nigro-punctati. Long. ♂ 12 mm.

Queensland.

I have much pleasure in dedicating this fine insect to Mr. Ch. French. It is very distinct from *B. rugicollis*, Westw., the only species hitherto recorded from Australia.

Sub-fam. EUSTHENINÆ.

Coptopelta, n. gen.

Caput parvum, transversum, subtriangulare, lateribus sinuatum, jugis tylo longioribus et ante hunc per spatium longiusculum contiguis, ocellis inter se atque ab oculis subæque longe distantibus, antennis quinque-articulatis, articulo primo apicem capitis superante, secundo primo vix triplo longiore, tertio brevissimo, primo paullo breviore, quarto secundo subæquali, quinto quarto breviore, bucculis rotundatis, rostro coxas medias subattingente, articulo secundo apicalibus duobus unitis longiore, quarto tertio æquilongo. Pronotum basi subrectum, retrorsum haud productum, marginibus lateralibus anticis integris, reflexis, angulis lateralibus rotundatis, haud prominulis. Scutellum latitudine distincte longius, medium abdominis haud attingens, apice truncatum. Frena medium scutelli superantia. Mesosternum medio convexiusculum, nec carinatum nec sulcatum. Metasternum medio haud elevatum; ostia odorifica longiuscule auriculata. Corium scutello multo longius, margine apicali sinuatum; membrana areis basalibus destituta, venis longitudinalibus e vena transversa basali exeuntibus. Abdomen e latere visum retrorsum parum attenuatum, lateribus leviter explanatum, segmento secundo ventrali basi obtuse tuberculato, angulis apicalibus segmentorum (primo excepto) acute prominulis, sutura inter segmentum primum et secundum ventrale latera versus antrorsum curvata et

oblitterata, spiraculis leviter transversis, ante medium segmentorum sitis, e latere longissime distantibus, segmento sexto ventrali feminæ medio supra segmentum genitale libere nonnihil producto et obtuse bidentato. Pedes approximati, femoribus inermibus, tibiis femoribus brevioribus, supra sulcatis, tarsis triarticulatis.

This genus belongs to the group *Oncomerina* of Stål, and is well distinguished from the other genera of the group.

5. *Coptopelta crassiventris*, n. sp.

Subtus cornea, supra castanea, pronoto paullo pallidiore, marginibus lateralibus anticis pronoti et connexivo nigris, segmentis hujus macula media rufescente notatis, linea intralaterali pronoti, macula ad angulos basales scutelli hujusque linea longitudinali postmediana et apice luteis, exocorio subolivaceo, antennis pallide ferrugineis. Pronotum subrugosum et punctatum, marginibus lateralibus anticis levissime rotundatis. Scutellum punctatum. Hemelytra apicem abdominis paullum superantia, corio crebre subtiliter punctulato, membrana ænea. Abdomen lateribus subtiliter crenulatum, connexivo longitudinaliter striguloso, ventre læviusculo, latera versus ruguloso, sed limbo laterali explanato lævigato, spiraculis nigris. Pedes badii. Long. ♀ 24 mm.

Queensland.

It is possible that the colour of the upper side of the body is more greenish or olivaceous in the living insect.

N.B.—For an Australian genus of this group *Oncoscelis*, Westw., the name of which is preoccupied (Chevrolat, Coleoptera, 1834), I have proposed the name *Rhœcus* (Revue d'Entom., 1891, p. 214); but as also this name is preoccupied by Clark for a genus of Coleoptera (1860), I herewith substitute the name *Rhœcocoris* for Westwood's genus.

Fam. ACANTHOSOMIDÆ.

6. *Stauralia compuncta*, n. sp.

Ovalis, dilute subvirescenti-testacea, margine laterali capitis et prothoracis, parte basali pronoti, scutello (parte basali excepta), exocoris a basi ad medium, margine apicali corii lineaque intra-

Queensland.

Quite unlike anything hitherto known in the genus.

Fam. LYGÆIDÆ.

Sub-fam. GEOCORINÆ.

9. *Germalus victoriæ*, n. sp.

Oblongas, pallide flavo-testaceus, callo humerali pronoti fusco-nigro, ventre plerumque vitta rosea utrinque ornato. Caput impunctatum, rostro coxas medias attingente, summo apice articuli antennarum secundi tertiique et articulo quarto toto fuscis, articulo tertio secundo distincte breviore. Pronotum antrorsum levissime angustatum, remote nigro-punctulatum, anterius utrinque area impunctata præditum, lateribus rectis, margine basali rotundato. Scutellum callo curvato lævi basali vittam lævigatam subelevatam ad apicem emittente instructum, lateribus sat profunde fusco-punctatum. Pectus utrinque punctis parcis minutis nigris in vittam angustam ordinatis instructum. Hemelytra pellucida, extus leviter rotundata, clavo serie punctorum fuscorum completa et serie altera brevi ad commissuram instructo, corio serie punctorum completa ad suturam clavi et serie subcostali longius pone medium abrupta prædito, hac serie prope basin margini costali parallela, deinde ab hoc sensim divergente, disco corii præterea pone medium in dimidio externo parce punctulato, punctis fuscis. Abdomen dorso vittis duabus sinuosis nigris in segmento quinto conjunctis et ad apicem communiter continuatis signatum, segmento dorsali tertio et quarto et præterea macula parva media nigra notatis. Pedes minute et parcissime fusco-punctulati, interdum fere impunctati. Long. ♂ ♀ 4·4—4·7 mm.

Victoria.

The genus *Germalus*, Stål, was hitherto only known from Madagascar and the Phillipine Islands.

10. *Geocoris provisus*, n. sp.

Niger, capite subtus (excepta macula parva basali utrinque prope oculos) cum margine antico toto, orbita posteriore oculorum, vitta laterali pronoti, vitta media scutelli basin hujus haud attingente, angulis posticis metasterni limboque laterali abdominis

(ad marginem posticum segmentorum anguste fusco-interrupto) pallide flavis, impunctatis, margine laterali corii ferruginea, vitta anteriore corii medium hujus attingente albido-decolore. Caput basi pronoti perpaullo latius, dense punctulatum, margine antico inter oculos et antennas leviter rotundato, antennis testaceis, articulo secundo basi et quarto toto fuscis, tertio dimidio basali nigro. Pronotum transversum, parce fortiter punctatum, ante medium utrinque callo transverso lævi præditum, mox intra latera serie punctorum instructum, marginibus lateralibus e basi ad angulum posticum oculorum levissime convergentibus, deinde pone oculos, quos tangunt, valde convergentibus. Scutellum lateribus dense fortiter punctatum. Pectus sat dense et profunde punctulatum. Hemelytra apicem abdominis attingentia, clavo serie punctorum completa et serie postica interiore brevi instructo, corio in parte apicali exteriore parce fortius punctato, præterea seriebus duabus punctorum prædito, serie externa inter venam subcostalem et marginem costalem sita, serie interna clavo approximata, post medium ab hoc nonnihil divergente, apice extus curvata et secundum marginem apicalem continuata, inter partem posticam serisi internæ et clavi parce subconfuse punctato, membrana leviter infuscata, macula ad angulum basalem interiorem et venis albescentibus. Abdomen subtus læve. Pedes flavo-testacei. Long. ♀ 5 mm.

Victoria.

No species of the sub-family *Geocorinæ* was hitherto known from the Australian continent, but as the genus *Geocoris* is generally distributed throughout the world and is also found in New Caledonia, its occurrence in Australia is in no wise unexpected. I know a still undescribed Australian genus of *Geocorinæ*.

Sub-fam. MYODOCHINÆ.

11. *Clerada rufangula*, n. sp.

Crebre punctulata, nigra, angulis posticis prothoracis rufis, subtus, præsertim in medio segmentorum ventralium, piceo-tincta, annulo subbasali latiusculo articuli quarti antennarum albo. Caput subrhombeum, parte postoculari lateribus rotundata, oculo et ocello contiguis. Pronotum lateribus medio leviter sinuatum.

Hemelytra apicem abdominis nonnihil superantia. Pedes piceo-nigri. Long. ♀ 5·5 mm.

West Australia.

This is one of the most interesting insects that Mr. French has sent me. Of this genus a single species was known, *C. apicicornis*, Sign., with a vast geographical distribution, having been found in tropical America and Asia, and in the Mascarene and Seychelle Islands. From that species *C. rufangula* is easily distinguished by the very different colour-markings, and by having the head less elongated with the postocular part rounded on the sides and the ocelli contiguous to the eyes.

Sub-fam. HETEROGASTRINÆ.

Trisecus, n. gen.

Caput cum oculis apice pronoti latius, nonnihil exsertum, subæque longum ac latum, parte anteoculari longitudine fere duplo latiore, lateribus postocularibus parallelis, ocellis a basi capitis nonnihil remotis, inter se quam ab oculis plus quam duplo longius distantibus, tuberculis antenniferis valde declivibus, articulo primo antennarum paullo plus quam dimidio apicem capitis superante, secundo primo paullo plus quam dimidio longiore, tertio secundo paullo breviore, quarto tertio longitudine subæquali, bucculis brevissimis, rostro coxas medias attingente, articulo primo medium oculorum attingente, secundo primo longiore, apicem prosterni superante. Pronotum transversum, capite nonnihil longius, antrorsum fortiter angustatum, prope apicem fortius subrotundato-angustatum, annulo collari distincto instructum, basi late leviter sinuatum, paullo ante medium transversim, impressum, impressione latera haud attingente, marginibus lateralibus obtusis, convexis, lobo antico sat convexo. Scutellum subæquilaterum, dimidio apicali calloso, callo antice angulariter sinuato. Hemelytra apicem abdominis longius superantia, clavo vix punctato, sed lineis tribus impressis subtiliter punctulatis instructo, lineis duabus exterioribus ad suturam clavi approximatis, interstitio angusto convexo separatis, linea interna secundum marginem scutellarem et commissuram currente, a linea media intervallo lato plano disjuncta, commissura scutello longitudine subæquali, corio ad venas subtiliter punctato-striato,

ceteroquin impunctato, margine costali acuto, fere usque ad apicem leviter reflexo, margine apicali subrecto sutura clavi parum breviore, venis pone medium furcatis, cellulas tres magnas apicales rhomboidales formantibus, membrana cellulis duabus magnis basalibus venas simplices emittente prædita, sed inter has cellulas et angulum basalem interiorem venis duabus e basi membranæ exeuntibus venula transversa haud conjunctis instructa, exteriore longa, curvata, subdichotoma, interiore recta, simplice, margini interno membranæ valde approximata. Alæ hamo e vena subtensa emisso, basi alæ approximato instructæ. Abdomen subtus transversim valde convexum, segmento genitali maris magno, convexiusculo, recurvo, partem apicalem superiorem abdominis occupante, hamis copulatoriis longis, leviter curvatis, prope basin geniculatim inflexis. Pedes simplices, femoribus anticis parum incrassatis, inermibus, tibiis rectis, subtiliter et molliter pilosulis, articulo primo tarsorum posticorum articulis duobus ultimis unitis subæque longo.

This singular and aberrant genus seems to be allied to *Idiostolus*, Berg, from Basket Island (Cape Horn), but I think they cannot be identical. In his description of *Idiostolus* Professor Berg says that there is no *hamus* to the wings. But if in this genus the *hamus* has the same unusual place as in *Trisecus*, Professor Berg has possibly overlooked it.

12. *Trisecus pictus*, n. sp.

Oblongus, nitidus, læviusculus. Caput nigrum, substrigulosum, parcius pallido-sericeum, clypeo piceo, apice cum rostro testaceo, antennis pilosulis, nigris, articulo primo et basi secundi obscure testaceis, apice secundi et tertii albido-flavente. Pronotum læve, glabrum, basi quam apice fere duplo et dimidio latius, lateribus medio levissime subsinuatum, albido-flavens, linea impressa collare postice terminante et maculis duabus magnis subconfluentibus lobi antici fusco-piceis, macula media ovali et vitta utrinque laterali obliqua subcurvata lobi postici fusco-nigris, lobo antico postice in medio impresso, impressione carinula longitudinali divisa. Scutellum glabrum, dimidio basali transversim striguloso, nigro, dimidio apicali calloso lævi albido-flavente, linea tenui longitudinali pallide fusca partito. Pectus parce sericeum, fuscum, mesopleuris maxima parte et macula quadrata prope

angulos posticos metasterni nigris, margine antico, laterali ac postico prosterni, macula transversa apicali mesopleurarum, margine angusto laterali et postico metasterni acetabulioque omnibus albidis. Hemelytra glabra, corio et clavo albido-flaventibus, macula magna oblonga media interna clavi, macula oblonga media pone basin corii, macula hujus oblonga laterali mox pone medium, parte posteriore cellulæ apicalis externæ, macula ad basin cellulæ apicalis mediæ limboque intra venam cellulam apicalem internam extus terminantem fusco-nigris, membrana subhyalina, vitta media cum macula permagna apicali confluente maculaque elongata ad marginem interiorem fuscis. Alæ apicem versus leviter infuscatæ. Abdomen subtus læve, parce brevissime sericeum, ferrugineum, hic et illic præsertim lateribus infuscatum, segmento genitali maris medio leviter bi-impresso. Pedes graciliusculi, testacei, apice tibiarum et articulis duobus ultimis tarsorum fuscis, femoribus posticis paullo ante apicem leviter infuscatis. Long. ♂ sine membr. 5·7 mm.

Tasmania.

Fam. Reduviidæ.

Sub-fam. Harpactorinæ.

13. *Pristhesancus grassator*, n. sp.

Niger, ventre in piceum vergente, lobo antico pronoti, scutello, pectore (parte postica propleurarum excepta), coxis, trochanteribus, ima basi femorum, apice tibiarum tarsisque flavis, gula et lineola laterali anteoculari testaceis, ano flavescente. Caput pronoto paullo brevius, rostro piceo, articulationibus testaceis, articulo primo antennarum pronoto et scutello unitis nonnihil longiore, nigro, annulis duobus subobsoletis superne interruptis et apice testaceis, articulis tribus ultimis ferrugineis, secundo tertio fere dimidio longiore. Pronotum parce pilosum, lobo antico utrinque ante tubercula erecta cylindrica tuberculo parvo prædito, lateribus longitudinaliter bi-impresso. Scutellum parce longiuscule pilosum, tuberculo suberecto cylindrico apice integro. Corium parte apicali prolongata dilutius. Membrana et alæ hyalinæ. Abdomen lateribus rotundato-ampliatum, subtus subtiliter pulverulento-sericeum. Long. ♀ 21·5 mm.

Queensland.

14. *Havinthus obscurus*, n. sp.

Glabriusculus, niger, lobo postico pronoti, corio tibiisque fusco-testaceis, connexivo (apice segmentorum excepto) testaceo. Caput pronoto paullo longius, rostro piceo, basin capitis vix attingente, articulo primo parte anteoculari capitis plus quam duplo breviore, basin antennarum haud attingente, secundo primo duplo longiore, articulo primo antennarum capite nonnihil breviore. Pronotum fere in medio subconstrictum et transversim impressum, angulis apicalibus acute prominulis, lobo postico transversim ruguloso. Hemelytra (♀) abdomine nonnihil breviora. Femora granulata, antica praeterea subtus denticulis nonnullis armata; tibiæ anticæ quam femora sat multo breviores, posteriores femoribus longitudine subæquales. Long. ♀ 13·6 mm.

West Australia.

Somewhat resembling *H. pentatomus*, H. Sch., but at once distinguished by the much shorter basal joint of the rostrum, and the acutely produced fore angles of the pronotum.

15. *Havinthus rufovarius*, n. sp.

Breviter sat dense pilosus, niger, gula (excepta parte basali), parte anteoculari capitis (exceptis apice clypei et vitta laterali inter oculos et basin antennarum), maculis duabus magnis basalibus lobi antici pronoti, marginibus lateralibus posticis lobi postici pronoti, postscutello, basi clavi et corii hujusque fascia post medium, macula, magna marginali segmentorum tertii, quinti sextique abdominis solum apicem horum segmentorum liberum relinquente, fascia basali utrinque abbreviata segmentorum ventralium quinque primorum, macula magna media segmenti ventralis sexti totam longitudinem segmenti occupante et in segmentum genitale nonnihil extensa, trochanteribus, femoribus anticis (exceptis macula media supera et apice), parte basali et annulo subapicali femorum posteriorum, apice tibiarum tarsisque (apice excepto) laete rufis. Caput pronoto paullo longius, rostro apicem versus picescente, coxas anticas attingente, articulo primo parte anteoculari capitis paullulo breviore, secundo primo nonnihil longiore, articulo primo antennarum capiti æquilongo, articulo quarto lurido. Pronotum ante medium subconstrictum

et transversim impressum, angulis apicalibus subrotundatis, vix prominulis, lobo postico granulato-rugoso. Hemelytra (♀) apicem abdominis attingentia. Femora granulata; tibiæ anticæ apicem trochanterum attingentes, posteriores quam femora distincte longiorès. Long. ♀ 19 mm.

West Australia.

The insect described by Reuter as a variety of *H. longiceps*, Stål, is possibly a variety of *rufovarius*, which is certainly distinct from *longiceps*.

Sub-fam. ECTRICHODIINÆ.

Nebriscus, n. gen.

Caput supra convexum, pone oculos mediocres subovales parum prominulos rotundatum, subtus utrinque pone oculos subtumidum, parte ocellos gerente vix elevata, articulo secundo rostri primo crassiore et dimidio longiore, antennis in medio inter oculos et apicem capitis insertis, articulo primo capiti subæquilongo, secundo primo nonnihil longiore, tertio primo triplo breviore (ceteri articuli desunt). Pronotum ante medium leviter constrictum et transversim impressum, angulis apicalibus breviter prominulis, marginibus lateralibus posticis depressis et subelevatis, margine basali recto, lobo antico linea impressa longitudinali diviso, hac linea impressionem transversam pronoti interrumpente et ibidem utrinque ruga terminata, deinde per partem plus quam dimidiam lobi postici continuata et in hoc dilatata, lobo postico antico latiore, intra angulos laterales rotundatos linea impressa longitudinali subtilissime crenulata instructo, ceteris impressionibus pronoti lævibus. Scutellum transversum, impressum, mucronibus apicalibus late distantibus. Mesosternum medio carinis duabus antrorsum convergentibus instructum. Metasternum pone medium transversim impressum. Cellulæ membranæ ambæ ad basin subæque latæ, cellula exteriore retrorsum dilatata, cellula interiore exteriore multo breviore, leviter curvata, ubique æque lata. Pedes antici leviter, posteriores late distantes, femoribus inermibus, anticis ceteris paullo crassioribus, tibiis femoribus subæquilongis, apice dilatatis, fossa spongiosa instructis, tarsis elongatis, articulo apicali basalibus duobus unitis subæquilongo.

This genus seems to be allied to *Antiopula*, Bergr., from Ceylon, but is distinguished by the structure of the rostrum and the antenuæ.

16. *Nebriscus pupus*, n. sp.

Puberulus, lævis, nitidiusculus, hemelytris (excepto margine costali corii a basi ad medium) opacis, niger, capite, lobo antico pronoti et rugis duabus impressionis transversæ hujus, scutello, parte apicali angulari corii (excepto ipso angulo), parte anteriore prosterni maculaque parva laterali metasterni sanguineis. Caput latitudine distincte longius, rostro fusco-testaceo, antennis nigris. Pronotum transversum, lobo antico sat convexo. Pedes nigri, coxis, trochanteribus, apice tibiarum femoribusque anticis basin versus piceis. Long. 6·7 mm.

Victoria.

Although the abdomen is wanting I do not hesitate to describe this new genus, as it is the first Australian representative of this sub-family, and as it is easily recognisable by the characters given above. It is the smallest insect hitherto known of this sub-family.

Sub-fam. STENOPODINÆ.

17. *Pygolampis frenchi*, n. sp.

Subglabra, nigra, hemelytris in fuscum vergentibus, spinulis capitis, ima basi rostri, spinis apicalibus prosterni, margine angusto acetabulorum, guttulis duabus externis (anteriore rotundata, posteriore oblonga) areæ exterioris membranæ, angulis basalibus segmentorum abdominalium dorsoque abdominis a basi ultra medium luride albidis. Caput apice medio spinuloso-prominulum, subtus utrinque et ante et post oculos spinulosum, articulo primo antennarum capite paullo longiore, obscure testaceo, fusco-variegato, subtus (apice excepto) granulis piligeris instructo, secundo primo haud dimidio longiore, tertio primo plus quam quadruplo breviore, quarto tertio fere duplo longiore. Pronotum capite distincte longius, lobo antico medio longitudinaliter sulcato, lobo postico carinis duabus antrorsum convergentibus instructo, latera versus longitudinaliter impresso. Pectus, imprimis mesosternum medio, brevissime sericeum. Hemelytra

(♂) apicem abdominis attingentia. Abdomen (♂) apice utrinque in lobum breviusculum triangularem productum. Pedes albido-testacei, femoribus apicem versus, basi et apice tibiarum, annulo submediano tibiarum anteriorum tarsisque nigris, femoribus anticis parum incrassatis, subtus in dimidio basali denticulis tribus perminutis distantibus armatis, femoribus posticis abdomine paullo brevioribus. Long. ♂ 12·5 mm.

Victoria.

Allied to *P. foeda*, Stål, but it is smaller and differently coloured, the first antennal joint is shorter and the anteocular part of the head is toothed beneath.

Tammerfors, Finland,

December 1st, 1894.

MEETINGS OF THE ROYAL SOCIETY.

1894.

ANNUAL MEETING.

Thursday, 8th March.

The President (Professor KERNOT) in the chair.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1893.

The Council of the Royal Society herewith presents to the Members of the Society the Annual Report and Balance Sheet for the Year 1893.

The following Meetings were held, and Papers read during the Session:

March 9.—"Linguistic Points of Contact between the Aborigines of Australia and those of New Guinea," by Rev. John Mathew. "Notes on the Eocene Strata of the Bellarine Peninsula, with brief references to other deposits," by T. S. Hall, M.A., and G. B. Pritchard.

April 13.—"The Lizards Indigenous to Victoria," by A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S. (an interesting collection of Victorian Lizards was exhibited). "Further Notes on Australian Hydroids, with description of some New Species," by W. M. Bale, F.R.M.S. "Note on the Hatching of a Peripatus Egg," by Arthur Dendy, D.Sc. "A New Thermo-Electric Phenomenon," by W. Huey Steele, M.A.

May 11.—"Notes on the Saibai, Kaurarega and Gudang Languages, with remarks on Unsound Philological Methods," by Rev. Lorimer Fison, M.A.

June 8.—"Glaciation of the Western Highlands, Tasmania," by E. J. Dunn, (communicated by A. W. Howitt, F.G.S.) "Further Note on the Glacial Deposits of Bacchus Marsh," by C. G. W. Officer, B.Sc., and L. J. Balfour.

July 13.—"Notes on the Trawling Expedition at the Lakes Entrance," by T. S. Hart, M.A. "Defence of the Position—That there are Linguistic Points of Contact between the Aborigines of Australia and those of New Guinea, and corroboration of the theory that the Australian Aborigines entered the Continent on the New Guinea side," by Rev. John Mathew. "Some Statistics showing the extent of damage done to Members of the Medical Profession by the Abuse of Alcohol," by J. W. Barrett, M.D.

September 14.—"An Operculum from the Lilydale Limestone," by R. Etheridge, Junr., F.G.S. "Additional Notes on the Lilydale Limestone," by Rev. A. W. Cresswell. Mr. Elliott Cairns exhibited a number of Mineralogical specimens from Mount Wills, and made some remarks upon the occurrence of gold in granite in that locality. "Note from the Biological Laboratory of the Melbourne University, on a Crayfish with abnormally developed Appendages," by Arthur Dendy, D.Sc. "On the forthcoming meeting of the Australasian Association for the Advancement of Science," by E. F. J. Love, M.A.

October 12.—"Results of Observations with the Kater's Invariable Pendulums, made at the Melbourne Observatory, June-September, 1893," by Pietro Baracchi, F.R.A.S.

November 16.—"Observations on some new or little-known Land Planarians from Tasmania and South Australia," by Arthur Dendy, D.Sc. "Land Irrigation—Principles governing its economic application in warm climates," by Isaac Tipping, C.E.

December 14.—"Description of a New Half-Seconds Pendulum Apparatus for Gravity Observations," by R. L. J. Ellery, C.M.G., F.R.S., F.R.A.S. (The Apparatus referred to was exhibited). "Description of a New Chain Test Range at the Melbourne Observatory," by R. L. J. Ellery, C.M.G., F.R.S., F.R.A.S. "Preliminary Survey of Eucalyptus Oils of Victoria," by W. Percy Wilkinson. "The largest Australian Trilobite hitherto discovered," by R. Etheridge, Junr., F.G.S.

During the course of the year three Members, one Country Members and two Associates have been elected. Ten Members, two Country Members, and five Associates have reigned.

Your Council regrets to report the resignation, as one of the Honorary Secretaries and Member of the Council, of Dr. Arthur

Dendy, F.L.S., who leaves the colony to take up the position of Lecturer of Biology, at Canterbury College, Christchurch, in the University of New Zealand.

During his connection with the Society Dr. Dendy has acted in the capacity of Member of Council, Hon. Librarian, and during the past year as one of the Hon. Secretaries. In accepting Dr. Dendy's resignation the Council ordered the following resolution to be recorded in the minute book: "That Dr. Dendy's resignation of the position of one of the Secretaries of the Royal Society be accepted with great regret, and that a letter be written by the President conveying to him the Council's sincere appreciation of his great services both as Secretary and as Member of Council, and expressing the desire that, though removed to a distant colony, he will still continue his connection with the Society."

The Librarian reports as follows:—

"During the past twelve months the Library has steadily increased, 1212 books and parts of periodicals having been received. Very little expense has been incurred for binding, as only the Society's "Proceedings" and the Macleay Memorial volume have been bound. A new and handsome bookcase has been placed in the Library, to which it will form a much needed addition."

During the course of the year the following publications have been issued: "Proceedings," Vol. V. (new series), and Vol. VI. (new series).

The past year has been of necessity a very trying one to the Society in many ways, but at the same time it has had its satisfactory features, for notwithstanding an unavoidable falling off in the number of Members, the attendance at the monthly meetings has increased, and the papers and discussions have been fully up to the mark of those of previous years.

Whilst it may not at present be found possible to issue "Transactions," that of the "Proceedings" will continue as usual and the Council appeals confidently for support to the Members and Associates during the coming year.

The Honorary Treasurer in Account with the Royal Society of Victoria.

Dr.

	£	s.	d.	£	s.	d.
To Balance from 28th February, 1893 ...				£272	17	10
,, Government Grant—						
Balance of Vote 1892-93	£140	0	0			
Instalments, 1893-94 ...	190	0	0			
				330	0	0
,, Entrance Fees				8	8	0
,, Subscriptions—						
Members	£82	19	0			
Country Members ...	13	13	0			
Associates...	32	10	0			
Arrears	24	3	0			
				153	5	0
,, Rent of Rooms				14	10	0
,, Sale of "Transactions"				3	3	6
,, Interest				24	15	0
				£806	19	4

Cr.

	£	s.	d.
By Printing and Stationery	£353	15	9
,, Rates	3	10	0
,, Gas and Fuel	7	15	8
,, Salary &c., of Assistant Secretary ...	100	0	0
,, Shorthand Records	6	6	0
,, Hall-keeper's Allowance	6	0	0
,, Collector's Commission	10	14	0
,, Insurance	4	0	0
,, Postages and Telegrams	21	0	10
,, Repairs and Furniture	25	19	0
,, Books and Periodicals	8	1	0
,, Freight	5	8	0
,, Refreshments	5	5	5
,, Binding	34	11	9
,, Gravity Survey Expenses	11	16	6
,, Trawling Survey Expenses	5	1	8
,, Incidentals	8	15	5
,, Balance (28th February, 1894)	188	18	4
	£806	19	4

PUBLISHING AND RESEARCH FUND.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Fixed Deposit in Bank	£300	0	0	By Fixed Deposit in Bank of Australasia ...	£300	0	0
„ Interest on same	13	10	0	„ Interest Transferred to General Account	13	10	0
	£313	10	0		£313	10	0

Compared with the Vouchers and Bank Pass-book and Cash-book, and found correct,

C. R. BLACKETT,
Hon. Treasurer.

ROBERT E. JOSEPH, } *Auditors.*
H. MOORS, }

28th February, 1894.

On the motion of Professor KERNOT, seconded by Mr. H. R. HOGG, the Annual Report and Balance Sheet were adopted.

CHANGES IN THE LAWS.

The following changes were adopted on the proposal of Mr. E. J. WHITE, seconded by Mr. G. S. GRIFFITHS, that in Rule V. the words "two secretaries" be omitted, and the word "secretary" be inserted instead thereof, together with consequential changes in other laws.

ELECTION OF OFFICE-BEARERS AND MEMBERS OF COUNCIL.

The following were elected:—President: Professor W. C. Kernot, M.A., C.E. Vice-Presidents: E. J. White, F.R.A.S., and H. K. Rusden, F.R.G.S. Hon. Treasurer: C. R. Blackett, F.C.S. Hon. Librarian: E. F. J. Love, M.A. Hon. Secretary: Professor W. Baldwin Spencer, M.A. Members of Council: R. L. J. Ellery, F.R.S.; G. S. Griffiths, F.R.G.S.; Professor Orme Masson, M.A., D.Sc.; H. Moors; Rev. E. H. Sugden, B.A., B.Sc.; T. W. Fowler, M.C.E.

The Annual Meeting having been declared at an end by the President, an Ordinary Meeting was then held.

Mr. Fryett was elected, and Messrs. A. J. Campbell and J. A. Atkinson were nominated as Associates.

Mr. E. F. J. LOVE read a paper on "Observations made at Sydney with Kater's Invariable Pendulums during January and February, 1894." A discussion ensued, in which Professor KERNOT and Mr. WHITE took part.

Mr. DUDLEY LE SOUEF read a paper on "Description of some Birds' Eggs from North Queensland."

Mr. G. B. PRITCHARD read a paper entitled "Notes on some Lancefield Graptolites."

Two papers by Professor SPENCER: (1) "Note on the presence of *Peripatus insignis* in Tasmania," and (2) "Preliminary Notes on some Tasmanian Earthworms," were taken as read.

Mr. Tipping's paper on "Land Irrigation" was postponed.

Thursday, 12th April.

The President in the chair, and some twenty-six Members and Associates present.

Messrs. J. A. Atkinson and A. J. Campbell were elected Associates.

Mr. E. G. Hogg was nominated as a Member and Mr. Dudley Le Souef as an Associate.

An adjourned discussion on Mr. Love's paper on Kater's Pendulums, etc., was then held, in which the PRESIDENT and Messrs. ELLERY, BARRACHI, FOWLER and LOVE took part.

Mr. TIPPING then read a paper on "Land Irrigation—Principles governing its economic application." In the discussion which followed, the PRESIDENT and Messrs. ELLERY, FOWLER and EASTICK took part.

Two papers by Mr. T. S. Hall were, owing to lack of time, postponed.

Thursday, 10th May.

The President in the chair and twenty-two Members and Associates present.

Mr. E. G. Hogg was elected a Member, and Mr. Dudley le Souef an Associate.

A resolution was passed on the proposal of Mr. ELLERY, seconded by Mr. LOVE, congratulating the Rev. Lorimer Fison on the honour done to him by receiving an invitation to be a guest of the British Association during the course of its meetings in Oxford.

Mr. T. S. HALL read a paper on the "Geology of Castlemaine, with a subdivision of the Lower Silurian Strata, and a list of Minerals." In the discussion which followed, Professor KERNOT and Messrs. HOGG, PRITCHARD, GRIFFITHS and SWEET took part.

A paper by Mr. W. Percy Wilkinson "On the Sugar Strength and Acidity of Victorian Musts," was taken as read.

Thursday, 14th June.

The President in the chair.

Mr. M. J. Fardy was balloted for and elected an Associate.

Dr. J. W. BARRETT gave a Demonstration explanatory of the Modern Theories of the Coagulation of the Blood, and the action of Snake Venom on the Blood.

A paper was read by Messrs. OFFICER, BALFOUR and HOGG, on "Geological Notes on the Country between Strahan and Lake St. Clair, Tasmania." In the discussion of the paper Messrs. GRIFFITHS, HALL, PRITCHARD and the PRESIDENT took part.

Thursday, 12th July.

The President in the chair and some twenty Members and Associates present.

Mr. A. E. Kitson was nominated as an Associate.

Professor KERNOT read a paper on "The Best Form for a Balance Beam."

Dr. MACGILLIVRAY read a paper on "The Australian Species of Amathia."

A paper was communicated by Mr. R. H. MATHEWS, on "Aboriginal Rock Paintings and Carvings in New South Wales." In the discussion of the paper the PRESIDENT and Messrs. MATHEWS, DUNN, HALL, MCALPINE and LUCAS took part, and a letter on the subject was read from Mr. A. W. HOWITT.

Mr. G. B. PRITCHARD read a note on "The Occurrence of Fossil Bones at Werribee."

Mr. MCALPINE and Mr. J. G. O. TEPPER read a paper on "A New Stone-making Fungus—Laccocephalum basilapiloides."

Thursday, 9th August.

The President in the chair and some twenty-two Members and Associates present.

Mr. A. E. Kitson was elected an Associate.

Dr. Gardner was nominated as a Member, and Mr. W. H. Ferguson as an Associate.

Mr. MCALPINE and Mr. W. H. F. HILL read a paper on "The Entomogenous Fungi of Victoria, Part I.—Isaria oncopteræ."

Mr. RUSDEN read a paper on "Cremation and Burial in relation to Death Certification," and in a discussion of the same the PRESIDENT and Messrs. ELLERY, WHITE, TIPPING and Dr. JAMIESON took part.

Professor LYLE demonstrated Joly's Melting Point Apparatus, and Joly's Steam Calorimetre.

Mr. Ellery demonstrated a new Micrometric Machine, to be used in the measurement of the astrograph star plates, and in determining the size of the star discs for the estimation of stellar magnitudes.

Thursday, 13th September

Professor Kernot in the chair, and twenty-eight Members and Associates present.

Dr. Gardner was elected a Member, and Mr. W. H. Ferguson an Associate.

Messrs. W. H. F. Hill, J. Shephard, and T. S. Hart, M.A., were nominated as Associates.

Dr. Jamieson read a paper on "An Attempt to Estimate the Population of Melbourne at the present time." In the ensuing discussion Messrs. Rusden, White, Hogg, and Spencer took part.

Messrs. T. S. Hall and G. B. Pritchard read a paper on "The Older Tertiaries of Maude, with an Indication of the Sequence of the Eocene Beds of Victoria."

Mr. Pritchard communicated a paper by Mr. C. Hedley, on "A Molluscan Genus new to, and another forgotten from Australia."

Mr. A. Foster Smith exhibited a new Automatic Recording Compass. A discussion was held, and taken part in by Messrs. Ellery, Love, Yeates and the President.

Thursday, 8th November.

The President in the chair and twenty-six Members and Associates present.

The following Committees were elected :

(1) *Antarctic Committee*—Messrs. Kernot, Griffiths, Ellery and Rusden.

(2) *Port Phillip Biological* — Messrs. J. B. Wilson, McGillivray, Hall, Pritchard and Spencer (*Sec.*)

(3) *House Committee*—Messrs. Kernot, Masson, Blackett and Rusden.

(4) *Gravity Survey*—Messrs. Ellery, White, Masson, Lyle, Baracchi and Love (*Sec.*)

(5) *Printing*—Mr. Ellery, the Hon. Treasurer and Hon. Secretary.

Mr. W. Percy Wilkinson was nominated as a Member.

Messrs. Lidgey, T. S. Hart, Shephard and Hill were elected as Members.

Mr. G. B. PRITCHARD read a paper on "Contributions to the Palæontology of the Older Tertiary of Victoria—Lamellibranchs. Part I."

Mr. A. J. CAMPBELL read papers on (1) "Notes on Birds;" (2) "The Gymnorhinæ or Australian Magpies, with a description of a New Species." A discussion ensued, in which Messrs. WHITE, RUSDEN, LE SOUEF, SPENCER and DUNN took part.

Professor SPENCER read a paper on "Preliminary Notes on certain Marsupials from Central Australia," and a paper by Mr. MCALPINE on "Australian Fungi" was taken as read.

Thursday, 15*th December*.

The President in the chair.

Messrs. Moors and Gilbert were elected Auditors.

Dr. MACGILLIVRAY nominated for re-election the retiring Officers and Members of Council.

Mr. W. Percy Wilkinson was elected a member, and Mr. C. A. Robinson an Associate.

Mr. W. R. Bennetts, Junr., was nominated an Associate.

Mr. A. SUTHERLAND read a paper on "Some Quantitative Laws in Incubation and Gestation."

Messrs. A. H. S. LUCAS and C. FROST read a paper on a "Preliminary account of certain Lizards from Central Australia."

Dr. MACGILLIVRAY read a paper on "A Monograph of the Tertiary Polyzoa of Victoria."

Professor A. DENDY contributed a paper entitled: "Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., in the neighbourhood of Port Phillip Heads. Part I."

It was announced that Dr. MacGillivray's paper "A Monograph of the Tertiary Polyzoa of Victoria," would be published in the "Transactions" of the Society.

Report of the Gravity Survey Committee.

Since the date of the last Report, good progress has been made. Mr. Love has swung the Kater Pendulums at Sydney, and his results, combined with those of Mr. Baracchi for Melbourne, show that the difference between the values of gravity at the two places is very nearly as found by Lieut. Elblein of the Austrian Survey. Mr. Ellery has completed his Apparatus, in which Half-Seconds Pendulums are employed, and the work of determining the constants for them is partly done. Mr. Love has now taken them home to swing at Kew Observatory. It is hoped that the field work of the Survey may be commenced about the end of next year, but much still remains to be done in the way of testing the Apparatus, and it is impossible at present to speak positively on this point.

The Committee asks for re-appointment; and that the unexpended balance (£8 18s.) of the original grant may be placed at its disposal.

E. F. J. Love, *Secretary.*

Report of the House Committee.

Your Committee have to report that during the past year there has been very little for them to do. The house and grounds have been attended to. A new bell has been placed in the caretaker's house, which was urgently needed; the paths in the garden have been cleaned and a quantity of crude arsenic applied to destroy the weeds and prevent their growth; this was done without expense to your Committee.

C. R. Blackett, *Convener.*

Report of the Port Phillip Biological Committee.

Your Committee has to report that the work of determining the large collection of specimens collected by Mr. J. Bracebridge Wilson is slowly progressing.

The most important publication of the year, dealing with this, is Dr. Dendy's "Catalogue of Non-Calcareous Sponges, Part I.", which appears in this issue.

Mr. Hedley's paper on "A Molluscan Genus new to, and one forgotten from, Australia," describes specimens procured by Mr. Wilson.

Mr. G. B. Pritchard has examined the great majority of examples of Mollusca in the Port Phillip collection, and a description of these will appear in a general catalogue of Victorian marine Mollusca, which Mr. Pritchard is now engaged upon.

The specimens of "Chitonidæ" are now being examined by Mr. Sykes in England, and during the course of the coming year it is hoped that a descriptive catalogue of these will be issued.

Whilst in England Professor Spencer interviewed the specialists who are now engaged in describing the Tunicata, Polychæta, and Pycnogonida, and it is hoped that the results of their work will also be published during the course of the coming year.

W. Baldwin Spencer, *Secretary.*

LAWS.

Amended to December, 1894.

I. The Society shall be called "The Royal Society of Victoria." Name.

II. The Royal Society of Victoria is founded for the advancement of science, literature and art, with especial reference to the development of the resources of the country. Objects.

III. The Society shall consist of Ordinary Members residing within ten miles of Melbourne; Country Members residing beyond that distance; Life Members (Law XXV.), Honorary Members (Law XXIV.), Corresponding Members (Law LII.), and Associates (Laws XXV., XXVI., and LIII.), all of whom shall be elected by ballot. Members and Associates.

IV. His Excellency the Governor of Victoria, for the time being, shall be invited to accept the office of Patron of the Society. Patron.

V. There shall be a President, and Two Vice-Presidents, who, with twelve other Members, and the following Honorary Officers, viz., Treasurer, Librarian, and Secretary of the Society, shall constitute the Council. Officers.

VI. The Council shall have the management of the affairs of the Society. Management.

VII. The Ordinary Meetings of the Society shall be held once in every month during the Session, from March to December inclusive, on days fixed and subject to alteration by the Council with due notice. Ordinary Meetings.

VIII. In the second week in March, there shall be an Annual General Meeting, to receive the report of the Council, and elect the Officers of the Society for the ensuing year. Annual General Meetings.

Retirement of Officers.

IX. All Office-bearers and Members of Council except the six junior or last elected Members, shall retire from office at the Annual General Meeting in March. Should a senior Member's seat become vacant in the course of the year, it shall be held by his successor (under Law XIII.), as a senior Member, who shall retire at the next Annual General Meeting. The names of such retiring Officers are to be announced at the Ordinary Meeting in December. The Officers and Members of Council so retiring shall be eligible for the same or any other office then vacant.

Election of Officers.

X. The President, Vice-Presidents, Treasurer, Secretary, and Librarian shall be separately elected by ballot (should such be demanded), in the above-named order, and the six vacancies in the Council shall then be filled up together by ballot at the General Meeting in March. Those members only shall be eligible for any office who have been proposed and seconded at the Ordinary Meeting in December, or by letter addressed to the Secretary, and received by him before the 1st March, to be laid before the Council Meeting next before the Annual Meeting in March. The nomination to any one office shall be held a nomination to any office, the election to which is to be subsequently held. No ballot shall take place at any meeting unless ten members be present.

Votes required.

Members in arrear.

XI. No member, whose subscription is in arrear, shall take part in the election of Officers or other business of the meeting.

Address by the President.

XII. An address shall be delivered by the President of the Society at either a Dinner, Conversazione, or extra meeting of the Society, as the Council may determine in each year.

Vacancies.

XIII. If any vacancy occur among the Officers, notice thereof shall be inserted in the summons for the next meeting of the Society, and the vacancy shall be then filled up by ballot.

Duties of President.

XIV. The President shall take the chair at all meetings of the Society and of the Council, and shall regulate and

keep order in all their proceedings; he shall state questions and propositions to the meeting, and report the result of ballots, and carry into effect the regulations of the Society. In the absence of the President, the chair shall be taken by one of the Vice-Presidents, Treasurer, or Ordinary Member of Council, in order of seniority.

XV. The Treasurer may, immediately after his election, appoint a Collector (to act during pleasure), subject to the approval of the Council at its next meeting. The duty of the Collector shall be to issue the Treasurer's notices, and collect subscriptions. The Treasurer shall receive all moneys paid to the Society, and shall deposit the same before the end of each month in the bank approved by the Council, to the credit of an account opened in the name of the Royal Society of Victoria. The Treasurer shall make all payments ordered by the Council on receiving a written authority from the chairman of the meeting. All cheques shall be signed by himself, and countersigned by the Secretary. No payments shall be made except by cheque, and on the authority of the Council. He shall keep a detailed account of all receipts and expenditure, present a report of the same at each Council meeting, and prepare a balance-sheet to be laid before the Council, and included in its Annual Report. He shall also produce his books whenever called upon to do so by the Council. **Duties of Treasurer.**

XVI. The Secretary shall conduct the correspondence of the Society and of the Council, attend all meetings of the Society and of the Council, take minutes of of their proceedings, and enter them in the proper books. He shall inscribe the names and addresses of all Members and Associates in a book to be kept for that purpose, from which no name shall be erased except by order of the Council. He shall issue notices of all meetings of the Society and of the Council, and shall have the custody of all papers of the Society, and, under the direction of the Council, superintend the printing of the "Proceedings" and "Transactions" of the Society. **Duties of Secretary.**

Meetings of Council.

XVII. The Council shall meet on any day within one week before every Ordinary Meeting of the Society. Notice of such meeting shall be sent to every member at least two days previously. No business shall be transacted at any meeting of the Council unless five members be present. Any member of Council absenting himself from three consecutive meetings of Council, without satisfactory explanation in writing, shall be considered to have vacated his office, and the election of a member to fill his place shall be proceeded with at the next Ordinary Meeting of Members, in accordance with Law XIII.

Quorum.

Special Meetings of Council.

XVIII. The Secretary shall call a Special Meeting of Council on the authority of the President or of three Members of the Council. The notice of such meeting shall specify the object for which it is called, and no other business shall be entertained.

Special General Meetings.

XIX. The Council shall call a Special Meeting of the Society, on receiving a requisition in writing signed by twenty-four Members of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every Member at least ten days before the meeting.

Annual Report.

Auditors.

XX. The Council shall annually prepare a Report of the Proceedings of the Society during the past year, embodying the Balance Sheet, duly audited by two Auditors, to be appointed for the year at the Ordinary Meeting in December, exhibiting a statement of the present position of the Society. This Report shall be laid before the Society at the Annual Meeting in March. No paper shall be read at that meeting.

Expulsion of Members.

XXI. If it shall come to the knowledge of the Council that the conduct of an Officer, a Member, or an Associate is injurious to the interest of the Society, and if two-thirds of the Council present shall be satisfied, after opportunity of defence has been afforded to him, that such is the case,

it may call upon him to resign, and shall have the power to expel him from the Society, or remove him from any office therein at its discretion. In every case, all proceedings shall be entered upon the minutes.

Election of Members and Associates.

XXII. Every candidate for election as Member or as Associate shall be proposed and seconded by Members of the Society. The name, the address, and the occupation of every candidate, with the names of his proposer and of his seconder, shall be communicated in writing to the Secretary, and shall be read at a meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following Ordinary Meeting of the Society. The assent of at least five-sixths of the number voting shall be requisite for the admission of a candidate.

Votes required to admit.

Members shall sign laws.

XXIII. Every new Member or Associate shall receive due notice of his election, and be supplied with a copy of the obligation,* together with a copy of the Laws of the Society. He shall not be entitled to enjoy any privilege of the Society, nor shall his name be printed in the List of Members, until he shall have paid his admission fee and first annual subscription, and have returned to the Secretary the obligation signed by himself. He shall at the first meeting of the Society at which he is present, sign a duplicate of the obligation in the Book of the Laws of the Society, after which he shall be introduced to the Society by the Chairman. No Member or Associate shall be at liberty to withdraw from the Society without previously giving notice in writing to the Secretary of his intention to withdraw, and returning all books or other property of the Society in his possession. Members and Associates will be considered liable for the payment of all

Conditions of Resignation.

* The obligation referred to is as follows :—

ROYAL SOCIETY OF VICTORIA.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Royal Society of Victoria, and to observe its laws, as long as I shall remain a Member or Associate thereof.

(Signed)

Address

Date

subscriptions due from them up to the date at which they give written notice of their intention to withdraw from the Society.

Honorary Members.

XXIV. Gentlemen not resident in Victoria, who are distinguished for their attainments in science, literature, or art, may be proposed for election as Honorary Members, on the recommendation of an absolute majority of the Council. The election shall be conducted in the same manner as that of Ordinary Members, but nine-tenths of the votes must be in favour of the candidate.

Subscriptions.

Life Membership.

XXV. Ordinary Members of the Society shall pay two guineas annually, Country Members and Associates shall pay one guinea annually. Those elected after the first of July shall pay only half of the subscription for the current year. Ordinary Members may compound for all annual subscriptions of the current and future years by paying £21; and Country Members may compound in a like manner by paying £10 10s. Any Country Member having compounded for his subscription, and coming to reside within ten miles of Melbourne, must pay either the balance £10 10s. of the Ordinary Member's composition, or one guinea annually while he resides within ten miles of Melbourne. The subscriptions shall be due on the 1st of January in every year. At the commencement of each year there shall be hung up in the Hall of the Society a list of all Members and Associates, upon which the payment of their subscription as made shall be entered. During July, notice shall be sent to all Members and Associates still in arrears. At the end of each year, a list of those who have not paid their subscriptions shall be prepared, to be considered and dealt with by the Council.

Entrance fees, etc.

XXVI. Newly-elected Ordinary and Country Members shall pay an entrance fee of two guineas, in addition to the subscription for the current year. Honorary Members, Corresponding Members and Associates shall not be required to pay any entrance fee. If the entrance fee and subscription be not paid with one month of the notification of election, a second notice shall be sent, and if payment

be not made within one month from the second notice, the election shall be void. Associates, on seeking election as Ordinary or Country Members, shall comply with all the forms prescribed for the election of Members, and shall pay the entrance fee prescribed above of Ordinary or Country Members respectively.

XXVII. At the Ordinary Meetings of the Society the chair shall be taken punctually at eight o'clock, and no new business shall be taken after ten o'clock. Duration of Meetings.

XXVIII. At the Ordinary Meetings business shall be transacted in the following order, unless it be specially decided otherwise by the Chairman:— Order and mode of conducting the business.

Minutes of the preceding meeting to be read, amended if incorrect, and confirmed.

New Members and Associates to enrol their names, and be introduced.

Ballot for the election of new Members or Associates.

Vacancies among Officers, if any, to be filled up.

Business arising out of the minutes.

Communications from the Council.

Presents to be laid on the table, and acknowledged.

Motions, of which notice has been given, to be considered.

Notice of motion for the next meeting to be given in and read by the Secretary.

Papers to be read.

XXIX. No stranger shall speak at a meeting of the Society unless specially invited to do so by the Chairman. Strangers.

XXX. Every paper before being read at any meeting must be submitted to the Council. Papers to be first laid before Council.

XXXI. The Council may call additional meetings whenever it may deem it necessary to do so. Additional Meetings.

XXXII. Every Member may introduce two visitors to the meetings of the Society by orders signed by himself. Visitors.

Members may read papers.

XXXIII. Members and Associates shall have the privilege of reading before the Society account of experiments, observations, and researches conducted by themselves, or original papers, on subjects within the scope of the Society, or descriptions of recent discoveries, or inventions of general scientific interest. No vote of thanks to any Member or Associate for his paper shall be proposed.

Or depute other Members.

XXXIV. If a Member or Associate be unable to attend for the purpose of reading his paper, he may delegate to any Member of the Society the reading thereof, and his right of reply.

Members must give notice of their papers.

XXXV. Any Member or Associate desirous of reading a paper, shall give in writing, to the Secretary, ten days before the meeting at which he desires it to be read, its title and the time its reading will occupy.

Papers by Strangers.

XXXVI. The Council may for any special reason permit a paper such as is described in Law XXXIII., not written by a member of the Society, to be read by the Secretary or a Member.

Papers belong to the Society.

XXXVII. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to the Secretary, and shall remain in his custody.

Papers must be original.

XXXVIII. No paper shall be read before the Society or published in the "Transactions" unless approved of by the Council, and unless it consist mainly of original matter as regards the facts or the theories enunciated.

Council may refer papers to Members.

XXXIX. The Council may refer any paper to any Member or Members of the Society, to report upon the desirability of printing it.

Rejected papers to be returned.

XL. Should the Council decide not to publish a paper, it shall be at once returned to the author.

Members may have copies of their papers.

XLI. The author of any paper which the Council has decided to publish in the "Proceedings" or "Transactions" may have fifty copies of his paper on giving notice of his

wish, in writing, to the Secretary, and any further number on paying the extra cost thereof.

XLII. Every Member and Associate whose subscription is not in arrear, and every Honorary and Corresponding Member, is entitled to receive one copy of the "Proceedings" and "Transactions" of the Society as published. Newly-elected Members shall, on payment of their entrance fee and subscription, receive a copy of the volume of the "Proceedings" and "Transactions" last published. **Members and Associates to have "Transactions."**

XLIII. Every book, pamphlet, model, plan, drawing, specimen, preparation, or collection presented to or purchased by the Society, shall be kept in the house of the Society. **Property.**

XLIV. The Library shall be open to Members and Associates of the Society, and the public, at such times and under such regulations as the Council may deem fit. **Library.**

XLV. The legal ownership of the property of the Society is vested in the President, the Vice-Presidents, and the Treasurer for the time being, in trust for the use of the Society; but the Council shall have full control over the expenditure of the funds and management of the property of the Society. **Legal ownership of property.**

XLVI. Every Committee appointed by the Society shall at its first meeting elect a Chairman, who shall subsequently convene the Committee and bring up its report. He shall also obtain from the Treasurer such grants as may have been voted for the purposes of the Committee. **Committees elect Chairman.**

XLVII. All Committees and individuals to whom any work has been assigned by the Society shall present to the Council, not later than the 1st of November in each year, a report of the progress which has been made; and, in cases where grants of money for scientific purposes have been entrusted to them, a statement of the sums which have been expended, and the balance of each grant which remains unexpended. Every Committee shall cease to exist at the November meeting, unless then re-appointed. **Report before November 1st.**

Grants expire.

XLVIII. Grants of pecuniary aid for scientific purposes from the funds of the Society shall expire on the 1st of March next following, unless it shall appear by a report that the recommendations on which they were granted have been acted on, or a continuation of them be ordered by the Council.

Personal expenses not to be paid.

XLIX. In grants of money to Committees and individuals, the Society shall not pay any personal expenses which may be incurred by the Members.

Alterations of laws.

L. No new law, or alteration or repeal of an existing law, shall be made except at the Annual General Meeting in March, or at a Special General Meeting summoned for the purpose, as provided in Law XIX., and in pursuance of notice given at the preceding Ordinary Meeting of the Society.

Cases not provided for.

LI. Should any circumstance arise not provided for in these Laws, the Council is empowered to act as may seem to be best for the interests of the Society.

Corresponding Members.

LII. The Council shall have power to propose gentlemen not resident in Victoria, for election in the same manner as Ordinary Members, as Corresponding Members of the Society. The Corresponding Members shall contribute to the Society papers which may be received as those of Ordinary Members, and shall in return be entitled to receive copies of the Society's publications.

Privileges of Associates.

LIII. Associates shall have the privileges of Members in respect to the Society's publications, and at the Ordinary Meetings, with the exception, that they shall not have the power of voting; they shall also not be eligible as Officers of the Society.

The Royal Society of Victoria.

LIST OF MEMBERS,

WITH THEIR YEAR OF JOINING.

Patron.

Hopetoun, His Excellency the Right Honourable John Adrian Louis Hope, G.C.M.G., Seventh Earl of ... 1890

Honorary Members.

Agnew, Hon. J. W., M.E.C., M.D., Hobart, Tasmania ... 1888
Bancroft, J., Esq., M.D., Brisbane, Queensland ... 1888
Clarke, Colonel Sir Andrew, K.C.M.G., C.B., C.I.E., (*President*, 1855 *to* 1857), London. 1854
Forrest, Hon. J., C.M.G., Surveyor-General, West Australia. 1888
Hector, Sir James, K.C.M.G., M.D., F.R.S., Wellington, N.Z. 1888
Liversidge, Professor A., F.R.S., University, Sydney, N.S.W. 1892
Neumeyer, Professor George, Ph.D., Hamburg, Germany 1857
Russell, H. C., Esq., F.R.S., F.R.A.S., Observatory, Sydney, N.S.W. 1888
Scott, Rev. W., M.A., Kurrajong Heights, N.S.W. ... 1855
Todd, Sir Charles, K.C.M.G., F.R.A.S., Adelaide, S.A. ... 1856
Verbeek, Dr. R. D. M., Buitenzorg, Batavia, Java ... 1886

Life Members.

Barkly, His Excellency Sir Henry, G.C.M.G., K.C.B. (*President*, 1860 *to* 1863), Carlton Club, London. 1857
Bosisto, Joseph, Esq., C.M.G., M.L.A., Richmond ... 1857
Butters, J. S., Esq., Empire Buildings, Collins-street West 1860

Eaton, H. F., Esq., Treasury, Melbourne 1857
Elliott, J. S., Esq., Elsternwick 1856
Elliott, Sizar, Esq., Asling-street, Brighton Beach ... 1856

Fowler, Thomas W., Esq., 317 Collins-street 1877

Gibbons, Sydney W., Esq., F.C.S., c/o Mr. Lewis, 341 Bourke-street. 1854
Gilbert, J. E., Esq., Money Order Office, G.P.O., Melbourne 1872

Howitt, Edward, Esq., Rathmines-road, Auburn ... 1868

Love, E. F. J., Esq., M.A., Queen's College, University 1888

Mueller, Baron F. von, K.C.M.G., M.D., Ph.D., F.R.S. (*President*, 1859), Arnold-street, South Yarra. 1854

Nicholas, William, Esq., F.G.S., 5 Auburn Grove, Camberwell. 1864

Rusden, H. K., Esq., Ockley, corner of North-road and Hotham-street, Brighton. 1866

Selby, G. W., Esq., 99 Queen-street, Melbourne ... 1881

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